the OIL AND GAS JOURNAL

MAY 13, 1957

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Flooding Rates for maximum Oil Recovery

Basic mechanisms for water flooding, and tips on how to analyze performance

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Pickets Threaten Permian Basin Rigs p. 78

New Tool Keeps an Eye on Mud Properties p. 88

22-month test showed substantial savings from using

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JOURNAL News Letter

May 13, 1957
Tulsa, Oklahoma

Drilling contractors face their first union-labor trouble:

Unionists finally have opened a long-expected drive to organize drilling crews. The testing ground apparently is the Permian basin of West Texas. Here's the situation: About 150 union sympathizers picketed four rigs near Lamesa last week. Two were shut down for a brief time. Union leaders voiced threats to shut down drilling in the entire basin if their demands were not met.

Their demands: A 42-hour week with same pay for present 56 hours, transportation to and from rigs, paid vacation, larger crews, and safer rigs.

Basin contractors still are operating and plan to ride out the storm. They claim working conditions in the basin are as good as any in the industry. Contractors are caught in a familiar squeeze on the shorter hours and higher wages proposition. They are drilling fewer wells this year, and present footage prices just won't justify additional costs (P. 78).

Meanwhile, refiners may be nearing the final stage of their protracted dealings with O.C.A.W. union. The O.C.A.W. reportedly has lowered its wage goals from the 27-cent hourly boost it's been seeking unsuccessfully for 5 months.

Union officials are keeping any new goal secret. The new strategy is seen as an effort to convert a few offers of 6 per cent wage increases into a national pattern. These offers have been made by Sun to Independent unions and by Gulf to unorganized refinery employees. Most other industry offers so far have been for 5 per cent increases. In fact, some O.C.A.W. bargaining committees have accepted 5 per cent offers at isolated spots.

The strike threat is still being voiced by O.C.A.W. leaders. But their latest moves make possibility of any general strike more remote.

Eisenhower has thrown the support of his administration behind the Harris-O'Hara gas bill. But the administration is requesting some amendments that have gas producers worried.

The suggested changes: Delete the ban on use of cost by FPC as factor in reaching reasonable market price, and give FPC power to review price increases

which do more than reflect tax changes. Administration also has suggested that some control over "dump" gas should be imposed and that interstate pipelines should have power of eminent domain for developing underground storage. These developments highlighted opening hearings on the bill before House commerce committee.

Congress is keeping the oil imports pot boiling. But domestic producers still are waiting to see what the administration will do.

In Congress last week: Members of coal-producing states blasted the new delay on import controls. Wyoming's Senator O'Mahoney demanded that tariffs rather than quotas be used to keep imports down.

Administration machinery for controlling imports, meanwhile, is being held in abeyance while ODM Chief Gordon Gray completes talks with officials of the big importing companies. His report on the chances for any further voluntary controls will set the stage for any Eisenhower action.

EXPLORATION: Oil scouts are now exempt from the Wage Hour Law. They're administrative-type employees. That's the precedent-setting decision of a Tulsa federal court in a case involving Midstates Oil Corp. The ruling affects status of oil scouts in every company in the country. The Government had contended the scouts should not be classified as administrative employees and thus were under wage-hour provisions.

Chances appear good that royalty provisions of tidelands owned by California will be changed. The state Assembly last week approved three different changes in present law. All were sent to the Senate. Each has the same idea: Put minimum royalty at 16 2/3 per cent.

Phillips has joined the scramble for offshore drilling permits on Canadian side of Lake Erie. It has acquired three-fourths interest in an exploration license covering about 100,000 acres 30 miles southeast of Detroit-Windsor area. Phillips plans three offshore gas wells this year. It's part of the biggest natural-gas exploration drive in Ontario's history.

A combine of five American oil firms has won 148,200-acre concession in Venezuela's Gulf of Paria. Bonus bids totaled $100 million, about $670 an acre. The combine includes Continental, Texaco, Ohio, Cities Service, and Richfield.

Like to play hunches or the long shot? Keep an eye on eastern Arkansas. Aggressive lease plays are reported in that region. One company already has assembled a 2-1/2 million acre spread across nine counties. All this could be boomed or punctured by a 9,500-ft. wildcat planned for Prairie County by Panhandle Eastern Pipeline (P. 209).

DRILLING: Belgian and French financial interests have bought Brown Drilling Co. and affiliated firms of Long Beach, Calif. Present Brown management will operate the company's domestic and foreign interests--including expansions in France, Turkey, and Venezuela.

Drillers soon may get more protection against blowouts and lost circulation. A device ready to go on the market reportedly gives automatic, continuous recordings of weight, viscosity, gel strength, and temperature of muds as they circulate from the hole. It is called Mud Monitor and has been tested successfully in the field (P. 88).

Sharply rising costs of drilling, as most contractors realize, have contributed to the sharp first-quarter reduction in well completions over the country. The first-quarter report of one company underscores this. It showed that development costs for the 3 months were $3.5 million above a year ago. The company actually completed 6 per cent more wells than last year but its drilling and development costs rose more than 40 per cent. Factors were deeper wells and increased operations offshore.

PRODUCTION: One of the world's most intensively engineered water floods has reached the second phase of operations. The project is in Arkansas' prolific Magnolia field, where operators expect to recover 31 million barrels of extra oil.

The first phase has been completed with spectacular results. It consisted of shutting in inefficient producers, of completing new water input wells. The results: Producing units were cut from 97 to 37. Output climbed from 7,400 bbl. daily to 12,500 bbl. Water production dropped from 10,950 bbl. daily to 300 bbl. and gas-oil ratio from 1,000:1 to 756:1.

Phase two has just started. It calls for injecting water at just the right spots. The aim is to recover still more oil by preventing oil entrapment by water.

California's daily oil production is skidding--it's now near the 900,000-bbl. mark. There's little in sight now to indicate the trend will be checked. Reasons for the decline: Lack of new discoveries, poor quality of new wells, and high decline rate shown by oil fields in recent years. Political developments have dashed hopes that active offshore drilling might turn the tide this year.

Engineers are arguing heatedly these days on both sides of the question: Can water floods be curtailed? The Oil and Gas Journal is adding to the literature on this subject with a detailed report on the study made by three Humble scientists. They contend high rates of injection are not necessary and that the floods can be controlled (P. 98).

REFINING: Southern Natural Gas Co. is moving into refining with purchase of Suntide Refining Co.'s 65,000-bbl. refinery and products pipeline at Corpus Christi. It's a $50 million stock-purchase deal. Chief Suntide stockholder is Sunray Mid-Continent Oil. Southern Natural operates more than 3,800 miles of gas-transmission lines and gathering lines in the South and Southeast.

Two more majors will kick up the octanes of their premium gasolines as the 1957 motoring season opens. Indiana Standard will market a superpremium to replace its White Crown premium in the Midwest by May 15. It also will boost the octane rating of its regular. Tidewater plans to introduce a Super Extra Flying A gasoline to coincide with dedication of its new 130,000-bbl. daily Delaware refinery. It will be marketed on the eastern seaboard by Memorial Day.

Little further expansion in lubricating-oil facilities appears likely over the next year. Latest National Petroleum Association survey shows capacity for finished lube product of 181,170 bbl. per calendar day. Solvent extraction facilities could handle 217,610 bbl., solvent dewaxing 146,450 bbl., and propane deasphalting 61,400 bbl.

Interest of petrochemical companies in propane and butane continues brisk. But they also are looking for new sources for the heavier hydrocarbons. One independent refiner in the Midwest, aware of this, is prepared to supplement production of C_2 and C_3 output with higher olefins and paraffins to chemical companies. Look for more of this. However, it won't be on the same scale as ethylene, propane, propylene, butane, butylenes, and butadiene.

Kerosine has been picked as the fuel to fly Northeast Airlines' new turboprop Bristol Britannias. Shell will begin supplying the airline in November. The first craft will serve the East Coast. Refiners are closely watching other developments in commercial jet-fuel contracts. Deals for fueling turbojet craft due out next year also are expected to cover kerosine rather than JP-4 type fuel. But over the long haul cost is expected to be the paramount factor with dollar-conscious airlines.

NATURAL GAS: The battle for long-neglected gas markets in the Midwest is being resumed this week before the FPC. Four major pipeline groups are involved. And one of the big questions is whether the new market will be served exclusively with domestic gas or if Canadian gas will get a share. The lineup pits Northern Natural Gas, Peoples Gas, Light & Coke, and Michigan Wisconsin Pipe Line against Tennessee Gas Transmission and its associate, Midwestern (P. 75).

The Supreme Court says the FPC has authority to approve an independent producer's gas-sales contract even if it is for a limited period of time. Heretofore, FPC has refused to approve contracts with an expiration date.

PIPELINING: Two eye-openers from the A. P. I. Pipeline conference in Cleveland should give pipeliners pause:

...The industry faces a multimillion-dollar bill if it has to foot costs for relocating pipelines crossed by the 42,000-mile national highway program.

...Right-of-way costs are skyrocketing. They have ballooned from $300 to $500 per mile 30 years ago to nearly $5,000 per mile today. They may cost $10,000 to $20,000 tomorrow. One pipeline reportedly paid $40,000 recently for a single 1,000-ft. strip in Texas.

Foreign oil circles are buzzing over who'll get the Qum plum in Iran. One hitch to any deal is the need for a 1,000-mile big-inch crude pipeline to bring the crude to market. The line alone would involve perhaps $500 million. The Italians claim they've made a deal. Americans with no other Middle East interests are reported in the bidding. But the Iranians are leaning toward developing the field themselves.

A TIP: The people close to the Eisenhower administration are saying Robert B. Anderson, former deputy secretary of defense, will become secretary of the Treasury within the next few months. He is slated to succeed George M. Humphrey, who has long overstayed the length of time he intended to keep office. Anderson is former manager of the W. T. Waggoner, oil, cattle, and farming empire in Texas. He currently is president of Ventures, Inc., a Canadian mining company. His other Washington post was Secretary of the Navy in 1953-54.

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TECHNOLOGY—OPERATION

Drilling-Production

Effect of Oil-Recovery Rate in Water Flooding 98

By J. K. Jordan, W. M. McCardell, and C. R. Hocott

This article presents the results of a thorough investigation of effect of flooding rates on oil recovery. It is based on performance of actual floods, search of the technical literature, theoretical and lab studies of the physical factors, and analysis of evidence presented by those favoring high-rate floods. Conclusions based on these studies are: (1) High rates of injection with capacity production are not necessary to obtain maximum oil recovery. (2) Water floods can be curtailed without loss of oil recovery. (3) In natural reservoirs, reduction in the rate of water advance may enhance oil recovery as capillary forces act to make flooding more uniform.

Use of D.S.T. Data in Determining Reservoir Performance 136

By Albin J. Zak, Jr., and Phil Griffin III

Drill-stem-test data can be used in determining three very important elements of reservoir performance: (1) average formation permeability within the drainage area of the well; (2) well-bore damage or skin effect, and (3) initial reservoir pressure. A fourth element, open-flow potential of the well, is predicted through the use of fluid-recovery data obtained during the open-flow portion of the drill-stem test. Part 3 of a 4-part series.

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Designing Gas-Gathering Systems Using Electronic Computers 132

By A. E. Hass and J. B. Benear

Cities Service Oil Co. recently designed the gas-gathering system for Roberts Ranch gasoline plant in Midland County, Texas, using an electronic computer. It provided the usual advantages of high speed, greater accuracy, and releasing engineers for more productive work. In addition, the computer made it relatively simple to design a number of systems with different initial and terminal pressures and to compare the economics of each.

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Solving Maintenance Problems in Alkylation 143

By Larry Resen

Many maintenance problems crop up in alkylation units. They seem to call for more than the usual ingenuity in determining the proper solutions. Here are some rather typical problems and how they were handled successfully.

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New type of valve operates flexible liner hydraulically—T.C.C. unit turnaround is made in 8 days—New fire insulation protects equipment—Coke-cutting tool saves time and power—Relocation develops better vent trap.

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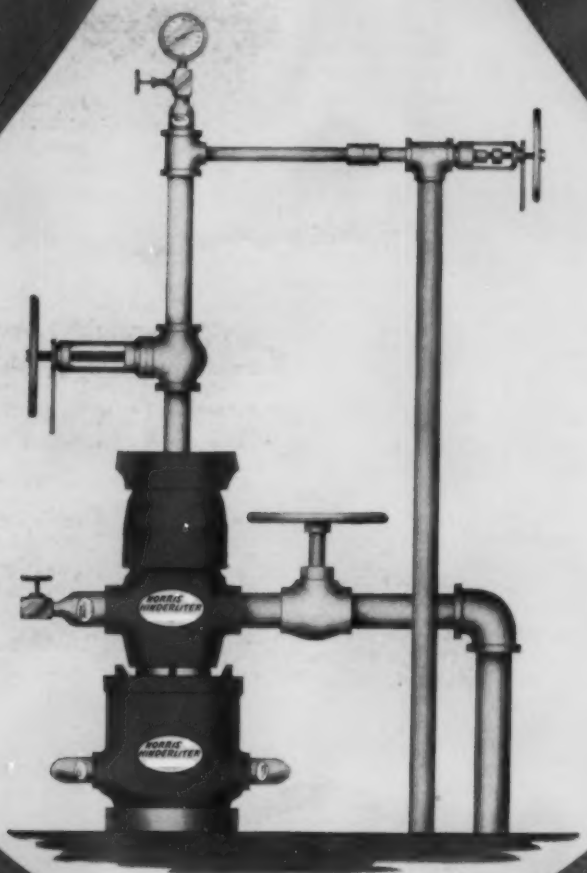

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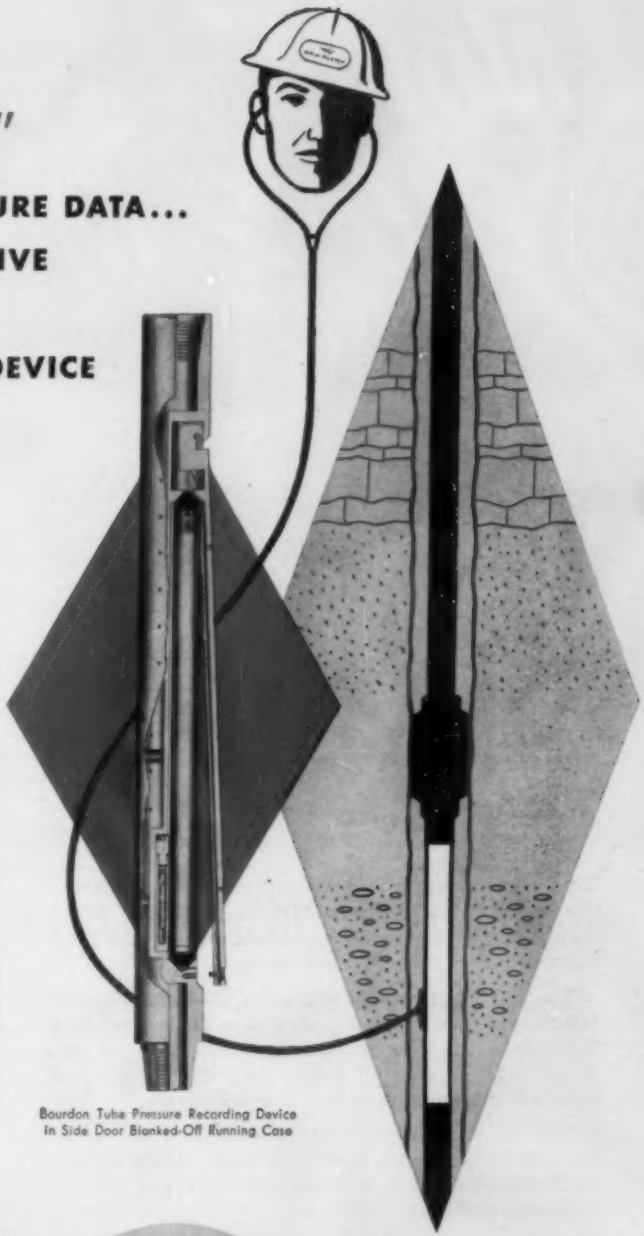

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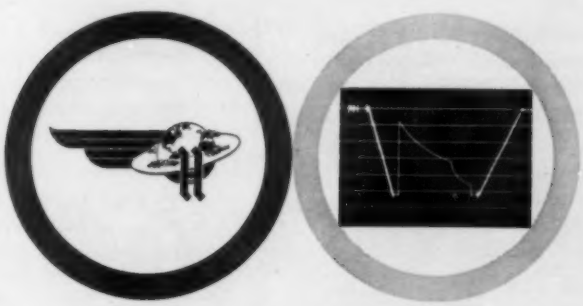

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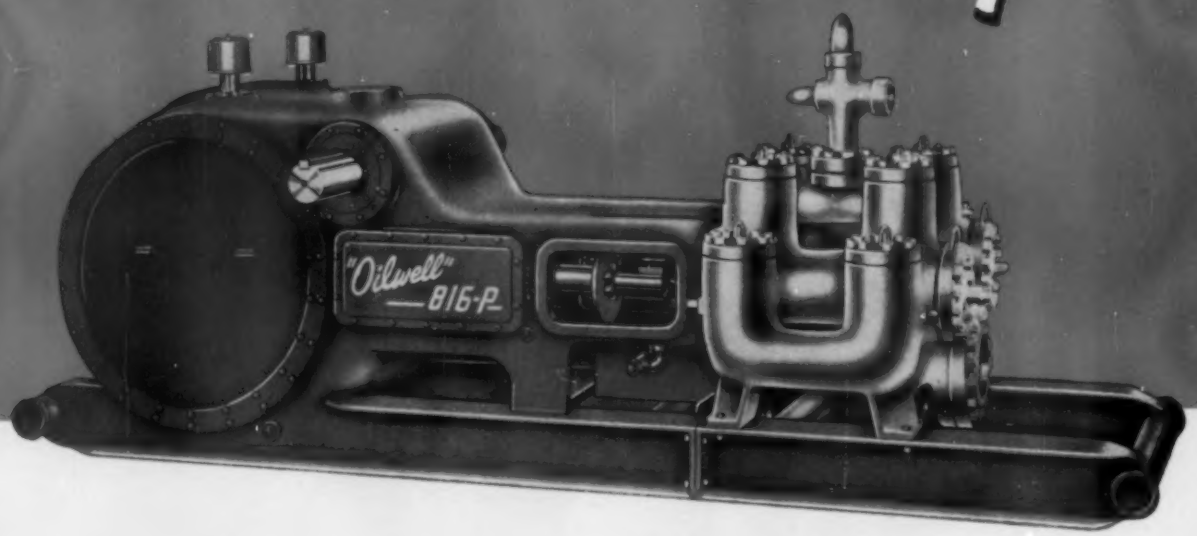

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7¾	1,280	12.24	367	490	612	674	735	796
7¼	1,478	10.61	318	425	531	584	637	690
7	1,593	9.85	295	394	493	541	591	640
6¾	1,725	9.10	273	364	455	500	545	591
6½	1,875	8.37	251	335	419	460	502	544
6	2,235	7.01	211	281	351	386	421	456
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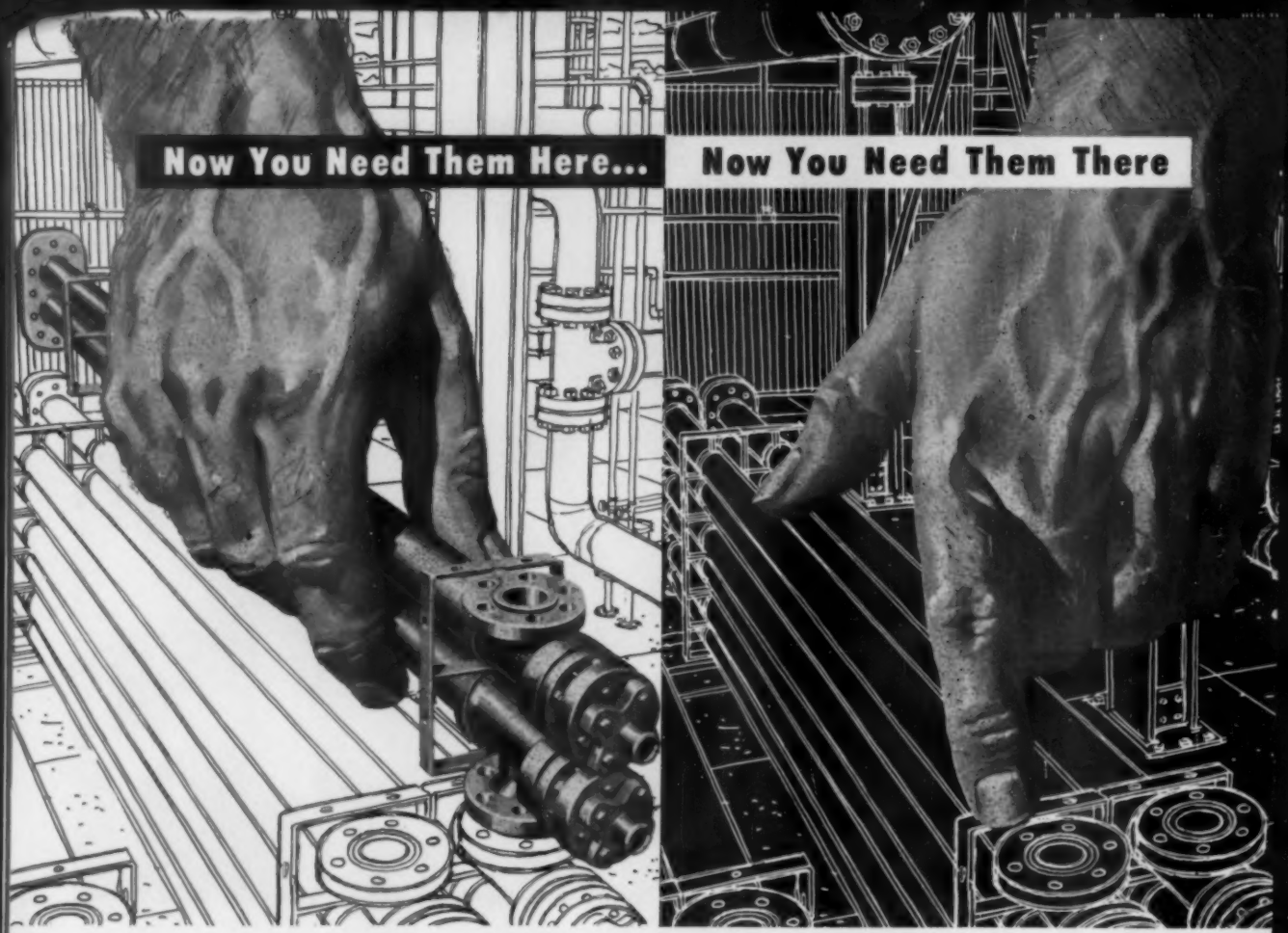

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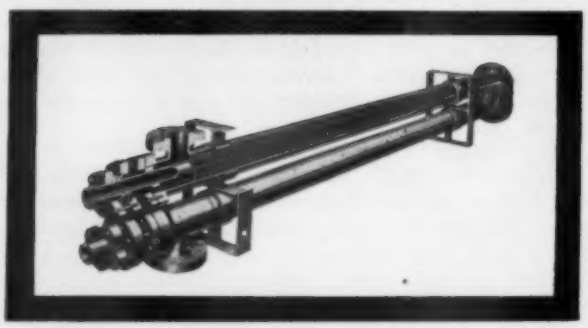
The flexibility of ALCOTWIN® heat exchangers means that you can change load or processes within your plant and still use the same heat-exchange equipment. You can easily add new ones for increased load, or you can rearrange present ones for changing conditions. They never become obsolete because of their unlimited number of applications.

ALCOTWINS are in stock in Beaumont, Texas, for immediate delivery when you need them. They are available off the shelf in a number of sizes, for pressures up to 600 psi and temperatures to 650° F.

You get real economy in first cost, in ease of installation and maintenance. In addition, you can select the precise metallurgy needed for best results in your application. The ALCO gas shielded tungsten arc welding method of fusing the fins to the tube permits the widest possible range of metallurgy.

Complete information is available from any of ALCO's sales offices. For a copy of Bulletins FH-3, write Petroleum Industry Equipment Division, Dept. AW-3, P. O. Box 1065, Schenectady, New York.



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A new name in pumping units

...AZTEC

built to outperform the best!

Before designing the new Aztec pumping unit, we studied the requirements of many oil producers. As a result, Aztec units combine *many important field-proven features* with the latest design principles developed through our own extensive manufacturing experience.

Standout features such as the rigidly braced, four-legged Samson Post, bronze bearings at saddle and equalizer, arc type hanger with vertical adjustment, herringbone gear reducer with positive bearing lubrication and roller bearings designed for over 100,000 hours B 10 life, help to make Aztec your best pumping unit buy.

Aztec units are available NOW in sizes up to 7,000 pounds API polished rod load capacity. Rapid expansion will soon make available a complete range of sizes of Aztec units. Ask your supply store for information and prices.

See the new Aztec pumping unit at your favorite supply store soon. Compare it, try it, and prove it's your best pumping unit buy.

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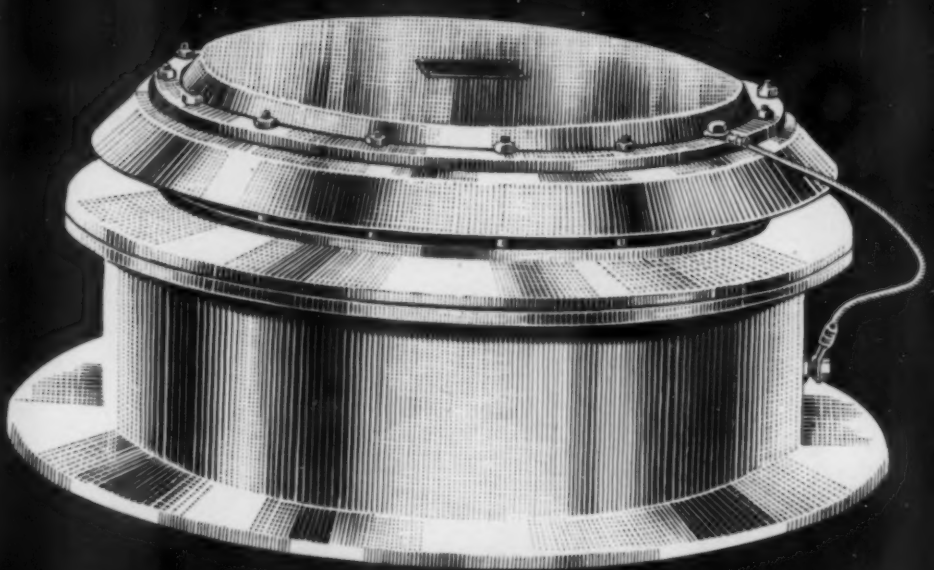
FORT WORTH, TEXAS

20" Emergency Pressure and Vacuum Relief



Illustrated here is the new S. & J. Model ST-5455 PV Emergency Vent, designed to cope with excessive internal pressure and vacuum conditions in above ground tanks of unlimited size.

Adapted to the standard 20" A.P.I. manhole, this emergency vent is sturdily constructed to resist mis-shaping by manhole flanges not perfectly flat. Entire cover can be lifted off base in a matter of seconds, providing clear and unobstructed passage through the 20" opening. No gaskets to replace—no unbolting is involved—removal speed is paramount.

Cover serves as pallet, and under severe conditions may rise out of manhole completely. A safety cable fastens cover to the base. Standard loading for pressure relief 1 oz./sq. in. and ¾" water for vacuum relief. Interested engineers are invited to request a copy of Engineering Data Sheet.

S&J

SHAND AND JURS CO.

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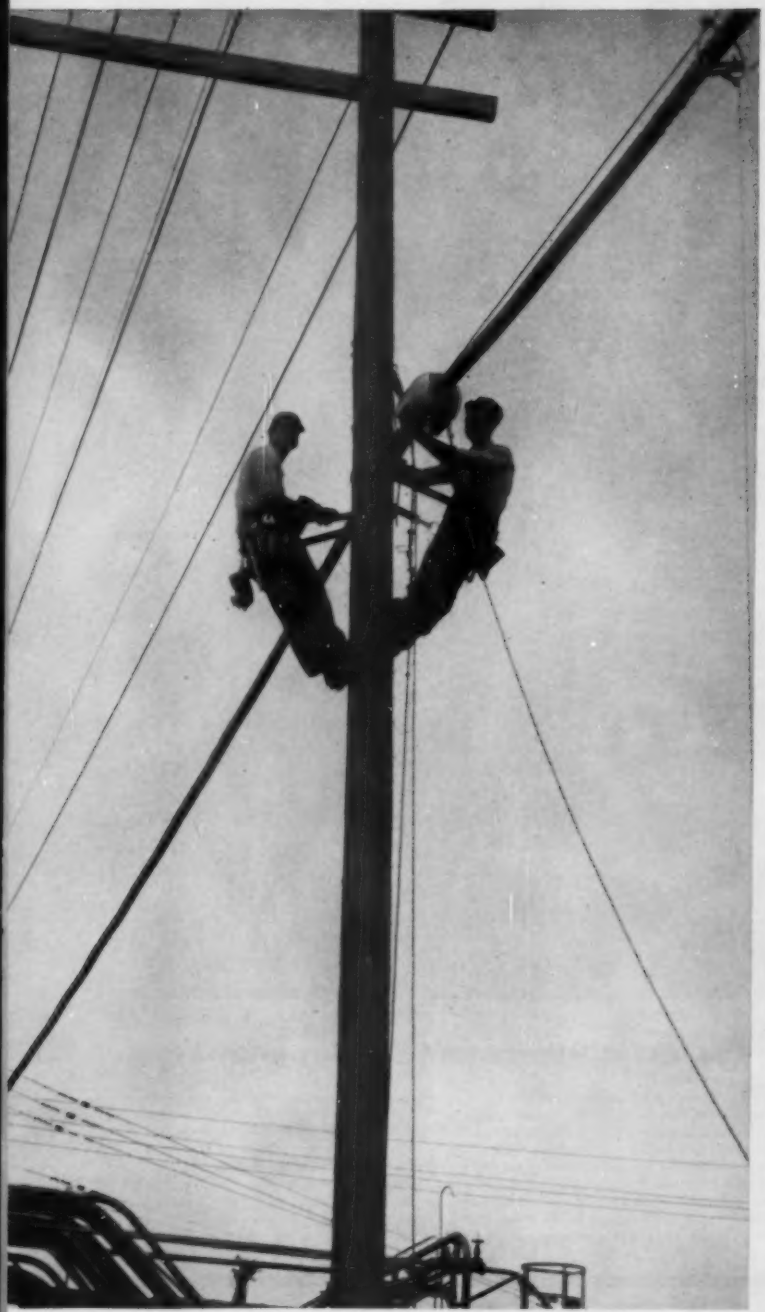
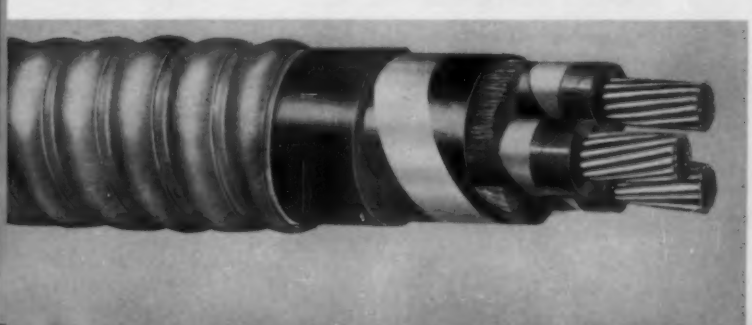
Speed new power on old poles—cut costs
with Anaconda Duralox Interlocked-armor Cable





METAL TAPE ARMOR AFFORDS HIGH PROTECTION AGAINST DAMAGE—NO CONDUIT NEEDED.

When a large Gulf Coast refinery needed additional power, the job was done *quickly* and *economically* because Duralox* could be strung on existing power-line poles—below the old lines. Neither new poles nor cross-arms were needed.

Installation time and costs are slashed with Duralox. Outdoors or in, it is readily trained around or over machinery, beams, piping and other obstructions in long, unbroken runs.

Duralox increases plant flexibility, affords easy maintenance and minimizes down time because it is generally accessible, easily relocated—100% salvageable. *Reg. U.S. Pat. Off. 57407

NEW BULLETIN DM 5606 contains full information about Anaconda Duralox Cable. Write for your free copy today. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

Ask the Man from

ANACONDA®
for DURALOX CABLE

EXISTING POLES are utilized at well-known refinery for additional power. Cable is Anaconda's 4/0 Awg Duralox Interlocked-armor Cable.

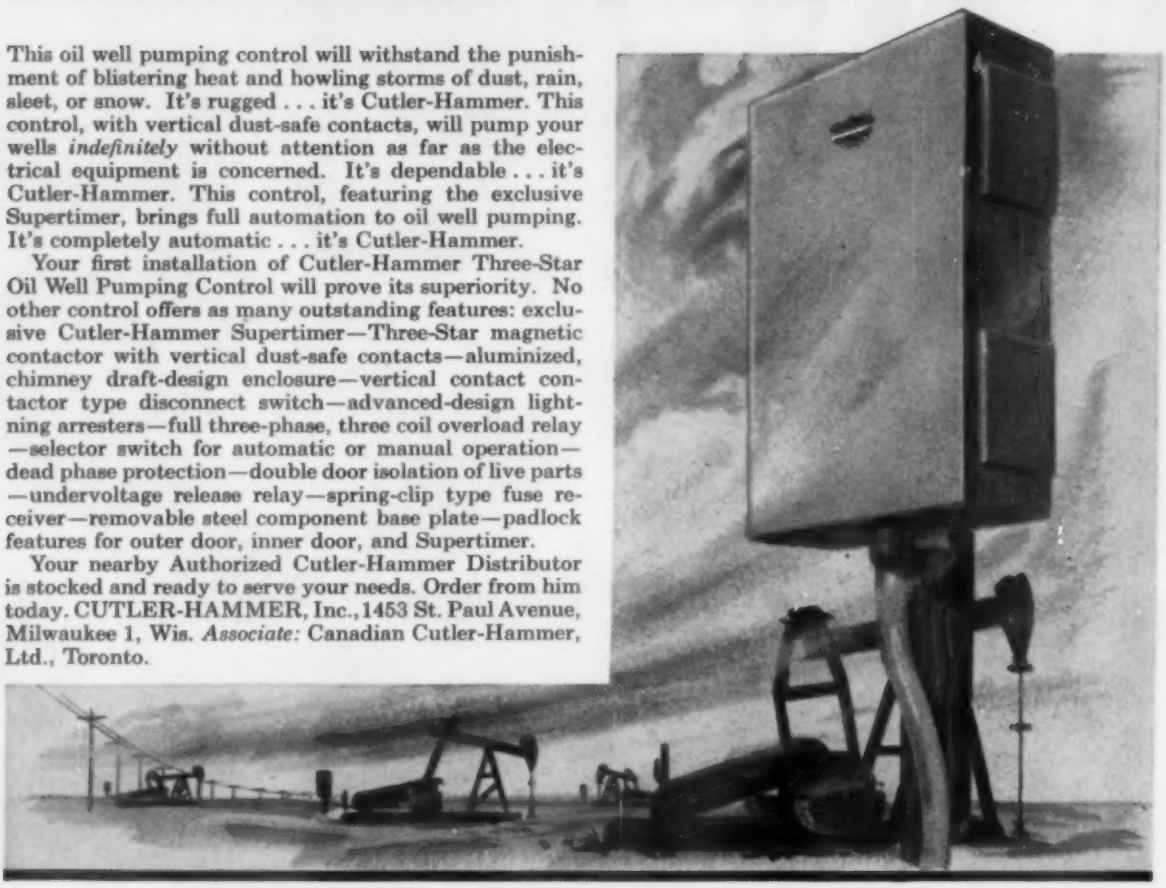
DURALOX CABLE is available in sizes No. 6 Awg to 750 Mcm—copper or aluminum conductors with rubber, plastic, or varnished-cloth insulation—up to 15kv. Underwriters' approved for 600 volts and 5000 volts, varnished-cloth insulation, galvanized steel armor!

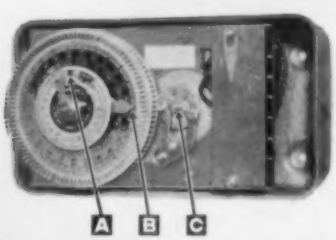
RUGGED. . . DEPENDABLE. . . COMPLETELY AUTOMATIC. . .

This oil well pumping control will withstand the punishment of blistering heat and howling storms of dust, rain, sleet, or snow. It's rugged . . . it's Cutler-Hammer. This control, with vertical dust-safe contacts, will pump your wells *indefinitely* without attention as far as the electrical equipment is concerned. It's dependable . . . it's Cutler-Hammer. This control, featuring the exclusive Supertimer, brings full automation to oil well pumping. It's completely automatic . . . it's Cutler-Hammer.

Your first installation of Cutler-Hammer Three-Star Oil Well Pumping Control will prove its superiority. No other control offers as many outstanding features: exclusive Cutler-Hammer Supertimer—Three-Star magnetic contactor with vertical dust-safe contacts—aluminized, chimney draft-design enclosure—vertical contact contactor type disconnect switch—advanced-design lightning arresters—full three-phase, three coil overload relay—selector switch for automatic or manual operation—dead phase protection—double door isolation of live parts—undervoltage release relay—spring-clip type fuse receiver—removable steel component base plate—padlock features for outer door, inner door, and Supertimer.

Your nearby Authorized Cutler-Hammer Distributor is stocked and ready to serve your needs. Order from him today. CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.





NEW CUTLER-HAMMER Supertimer

This is automation in action. You pre-set the Supertimer to meet your field allowable and the control will do the rest, automatically. It starts, stops, restarts and cycles indefinitely, precisely according to your schedule. If a power outage occurs, any number of C-H controlled pumps are automatically restarted in an exact sequence to avoid overloading the power lines on inrush. Unfortunate coincidental starting of even two pumps is impossible.

- (A) Sets the precise restarting time delay from zero to 180 seconds. This is exclusive with the Supertimer—unfortunate coincidental starts of even two pumps are impossible.
- (B) Sets the daily pumping schedule—pull a tab for each fifteen minutes of pumping, space them through the daily 24 hour period as desired.
- (C) Sets the weekly pumping schedule—1, 2, 3, 4, 5, 6 or 7 days per week as desired.

Member American Petroleum Institute

CUTLER-HAMMER
MOTOR CONTROL
C-H

COMPLETE PROTECTION. The control is protected against lightning with exclusive, advanced-designed lightning arresters; and the three coil overload relay protects the pump motor from overloading and dangerous single phasing which often results from lightning.

CHIMNEY DRAFT VENTILATION. The heat-reflecting, aluminized enclosure insures a constant circulation of air . . . no nuisance tripping because of trapped heat.

DUST-SAFE CONTACTS. Dust-Safe vertical contacts stay clean and eliminate the necessity of contact replacement.

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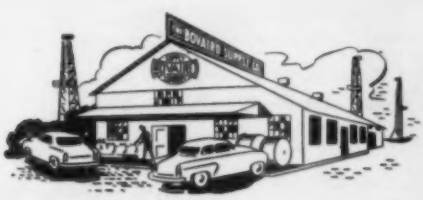

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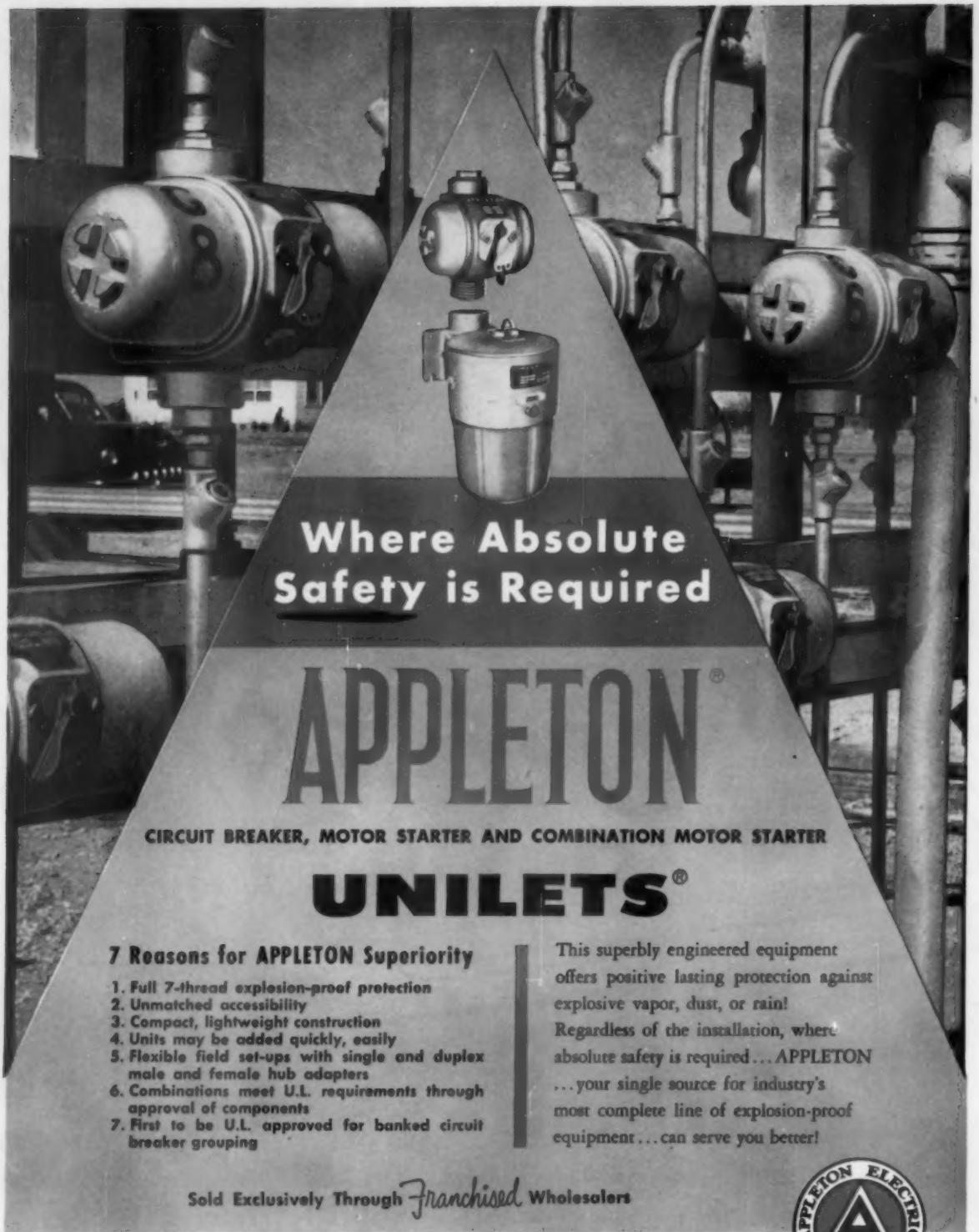

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CIRCUIT BREAKER, MOTOR STARTER AND COMBINATION MOTOR STARTER

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7 Reasons for APPLETON Superiority

1. Full 7-thread explosion-proof protection
2. Unmatched accessibility
3. Compact, lightweight construction
4. Units may be added quickly, easily
5. Flexible field set-ups with single and duplex male and female hub adapters
6. Combinations meet U.L. requirements through approval of components
7. First to be U.L. approved for banked circuit breaker grouping

This superbly engineered equipment offers positive lasting protection against explosive vapor, dust, or rain! Regardless of the installation, where absolute safety is required... APPLETON ...your single source for industry's most complete line of explosion-proof equipment... can serve you better!

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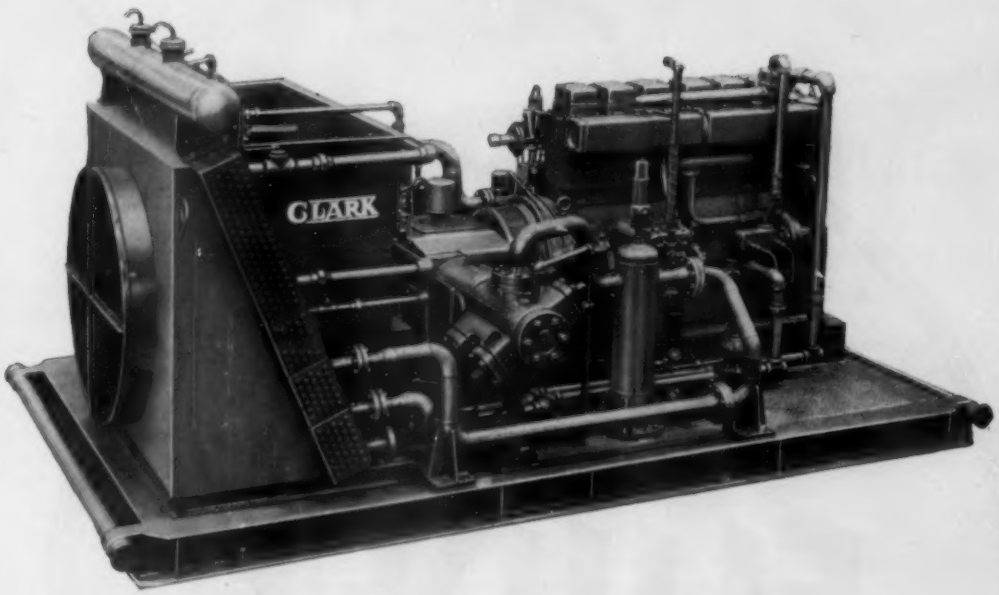


DIRECT DRIVE...

A unique feature of the Clark CFA Packaged Field Compressor

One of the simplest ways to take the bugs out of packaged field compressors is to direct-couple the compressor to the engine. Clark engineers did exactly that when they designed the new CFA. Troublesome, power-robbing belts and gears between the engine and the compressor are not required. A simple rubber block coupling takes their place. But this achievement was made possible only because the CFA is so perfectly balanced and therefore can operate at a modern 1,000 rpm. without a quiver or a shake. Furthermore, the CFA is typically Clark. It has the built-in stamina and precision of its big brothers. You'll deplete the field, but you won't wear out the Clark compressor.

There are two and four cylinder CFA models available in the 100-350 bhp. range. Your nearest Clark representative has all the facts and can tell you of other operators' experiences with the CFA.

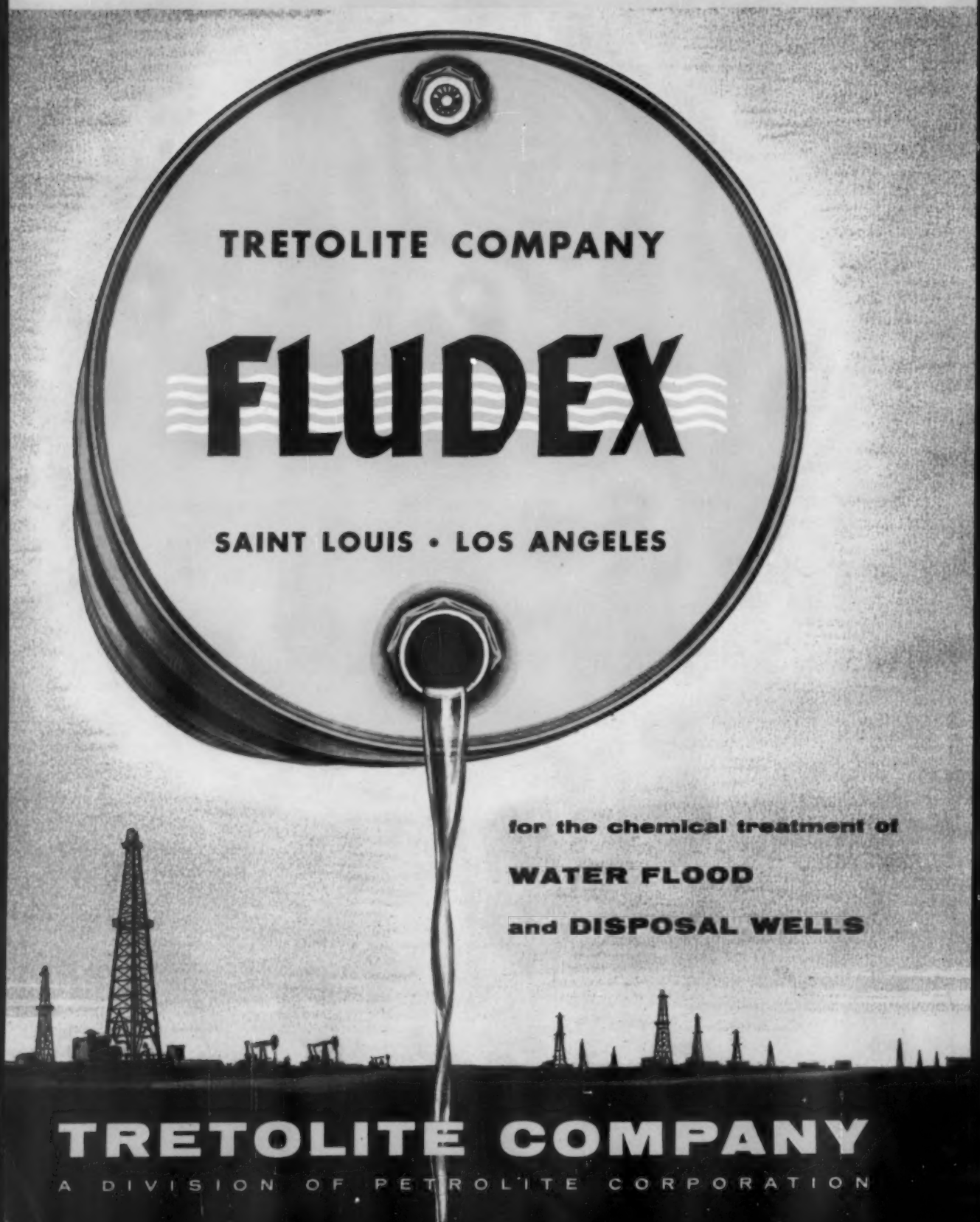
CLARK BROS. CO. **OLEAN, N. Y.**

One of the Dresser Industries

Offices in Principal Cities Throughout the World

CLARK **Packaged Field Compressors**

It's NEW from TRETOLITE!



TRETOLITE COMPANY

A DIVISION OF PETROLITE CORPORATION

FLUDEX

WATER FLOOD and WATER DISPOSAL STIMULATOR!

Enables Formations to Take More Water . . . at Lower Pressures . . . in Less Time

Newly developed FLUDEX, by Tretolite, is a multipurpose chemical formulation ideally suited for operations where combinations of scale, corrosion or bacteria are contributing to the malfunction of your flood or disposal system . . . and where the incompatability of certain treating agents applied to two or more of these damaging forms of attack may add further complication to the treating problems.

HERE'S WHAT FLUDEX DOES . . . AND HOW IT WORKS

FLUDEX may be fed diluted or undiluted into the injection system when continuous feed is employed. Normally FLUDEX is fed into the system on the suction side of the pressure pump. Batch treatment with FLUDEX is acceptable, depending on the system, but continuous feed is preferable.

Excellent Wetting Agent.

The injection of FLUDEX conditions the surfaces of the formation so it will absorb more water more quickly at lower operating pressures.

Kills Sulfate-Reducing Bacteria.

Sulfate-reducing organisms can cause considerable difficulty in injection systems. These bacteria have the ability to reduce sulfates to hydrogen sulfide. Soluble iron then becomes insoluble iron sulfide. FLUDEX is effective in destroying both aerobic and anaerobic organisms, and thus eliminating subsequential plugging.

Inhibits Corrosion.

By virtue of its bactericidal action, FLUDEX serves to inhibit corrosion by reducing the attack of hydrogen sulfide.

Aids in Deflocculation of Solids.

Strata solids and similar matter are suspended to prevent deposition. Precipitates, or suspended matter, are filmed as soon as they are formed—to eliminate the growth and eventual agglomeration of these objectionable deposits.

PROVED IN FIELD TESTS FROM COAST TO COAST!

Oklahoma Water Flood Reports Over 270% Increase in Injection Rate, 7% Decrease in Injection Pressure — in Just Nine Days!

Injection pressure at well head was 810 psi with plant pressure of 960 psi. Injection rate was 51 bbls of water per day. FLUDEX was introduced by chemcial pump at rate of two quarts per day. After nine days, injection rate was up to 190 bbls per day, injection pressure dropped to 750 psi.

Western Disposal Well Goes on Vacuum for First Time in 6 Years!

This well required acidizing every 30 to 45 days. Disposal water averaged 450 bbls per day on gravity feed. FLUDEX was introduced by lubricating 3 pints per day into disposal water. After 52 days operator cleaned well and again acidized. Well went on vacuum for first time in 6 years. At same treatment of 3 pints per day, well has been on vacuum at this writing for over 60 days.

YOURS FOR THE ASKING!

WRITE FOR FULL DETAILS

of this remarkable new product!

369 Marshall Avenue, Saint Louis 19, Missouri
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Chemicals and Services for the Petroleum Industry

DESALTING • DEMULSIFYING • CORROSION INHIBITING
SCALE PREVENTION • FUEL OIL ADDITIVES
WATER DE-OILING • METAL DEACTIVATORS

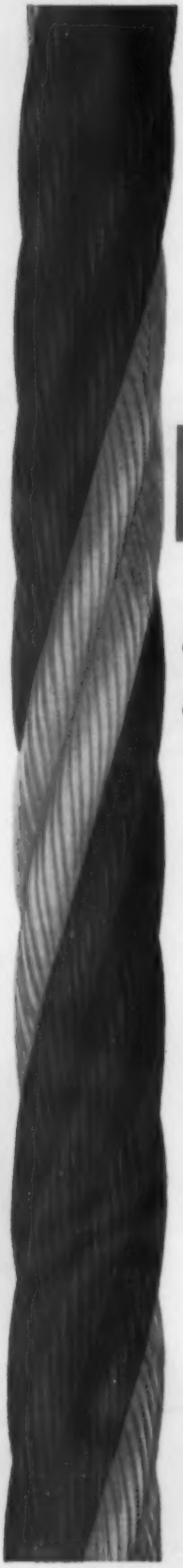
TRETOLITE COMPANY
369 Marshall Ave.
St. Louis 19, Mo.

Gentlemen:

I agree. FLUDEX sounds like a remarkable new product to me, and I want more information as soon as possible.

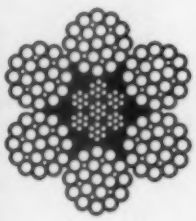
Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

TWF-57-1



WICKWIRE

DOUBLE GRAY



WIRE ROPE

An extra improved plow steel wire rope with independent wire rope core, Double Gray gives you a rated breaking strength that's 15% greater than the catalog breaking strength of ropes of the same size and type made from improved plow steel.

Double Gray is *not* a new rope . . . *not* a rope that's offered to you on an "experimental" basis. Instead, it's been thoroughly tested in both the field and the laboratory. This means that you can now get extra high strength ropes with greater abrasion and crushing resistance . . . *plus* the knowledge that you're using a *safe* wire rope that's made by a company long known for its top-quality products.

Contact your nearby Wickwire Distributor or CF&I sales office for complete details and recommendations for your particular applications.

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

CF&I WICKWIRE ROPE A CF&I PRODUCT

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PACIFIC COAST DIVISION—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.)
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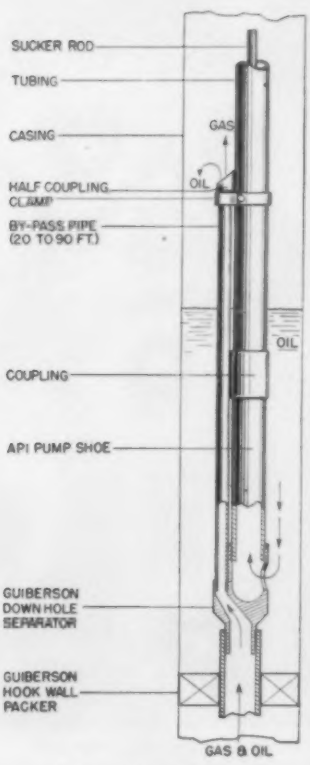
LOOK FOR THE YELLOW TRIANGLE

5078

Answer To An Old Problem!

Down Hole Separator



Schematic Installation

DOWN HOLE SEPARATOR

for pumping wells

The Guiberson down hole separator increases production and eliminates the problem of gas locks, etc., in pumping wells where the produced fluid has a high gas/oil ratio. Less than a foot in length, the separator is screwed directly into a Guiberson packer and the pump shoe fitted directly onto the separator. One to four joints of by-pass pipe, depending upon the producing characteristics of the well, are screwed into the separator and clamped to the tubing. Attached to the top of the by-pass pipe is a half-coupling cut on a diagonal which guides the unit past casing joints. By-pass pipe hugs the tubing as snugly as couplings permit. Production crosses over from the tubing below the packer into the annulus above it and is carried well above the pump shoe by the by-pass pipe. The large annulus above the packer allows the gas to break out of solution and the oil drops back to the large reservoir above the packer where it is picked up by the pump, comparatively free of gas. The separated gas is bled off of the casing continuously. Intake ports on the separator have a larger by-pass area than the tubing. The separator is precision machined from cast steel.

ENGINEERING DATA

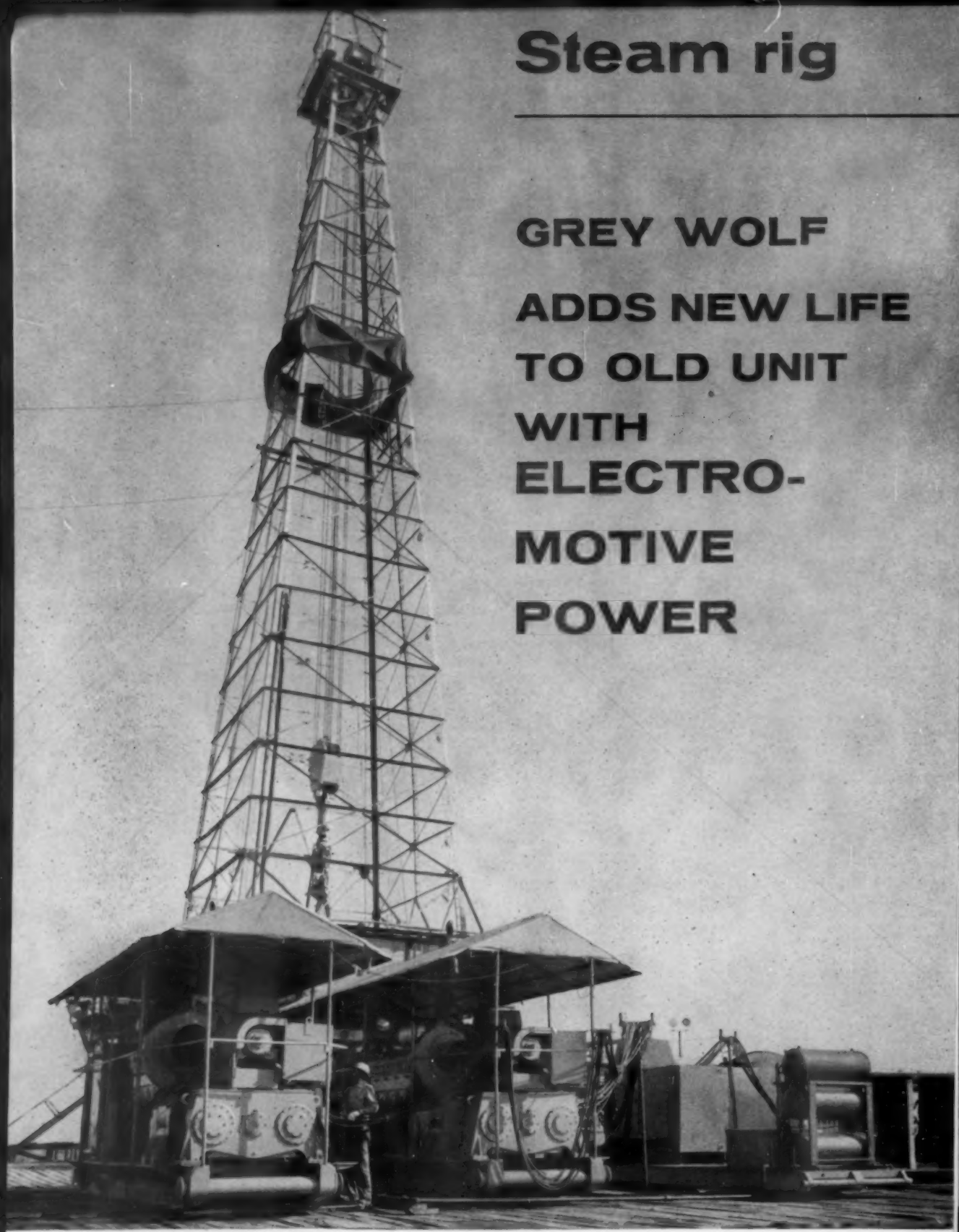
Part Number	Minimum Casing O.D.	Tubing Size And By-Pass	Maximum Metal O.D.	Approximate Weight	Approximate Length
29439	4½"	2" x 1½"	3¾"	12#	13¾"
29133	5"	2" x 1½"	4⅛"	14#	10½"
28369	5⅛"	2" x 2¼"	4½"	15#	10⅜"
28645	5½"	2" x 1"	4½"	15#	10⅜"
29606	5½"	2½" x 2¼"	4½"	15#	16"
28370	7"	2½" x 1"	5⅝"	20#	11⅛"

Note: The 4½" x 2" and 5½" x 2½" sizes have NUE 10 round top and EUE 8 round bottom field connections; all other sizes are EUE 8 round both ends. When ordering specify part number, casing, tubing and by-pass size.

SAFE THAN SORRY
BETTER BE
GUIBERSON
THE
GUIBERSON
CORPORATION
ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.
Sold by
Oil Field Supply Stores
Everywhere

Steam rig

GREY WOLF ADDS NEW LIFE TO OLD UNIT WITH ELECTRO-MOTIVE POWER



Two skid-mounted Electro-Motive 875-hp generating sets power Grey Wolf's recently converted rig. Each 8-cylinder engine drives two 500-kw dc generators that supply power to electric drive motors on draw works, rotary and mud pumps. Electrical control cabinet is located on skid to right of engines.

converted to Diesel-Electric

Grey Wolf Drilling Company of Houston expects its newly converted Diesel-Electric rig will cut rig-up time to three days—just half the time it took with the old steam unit.

In addition, "trips" are faster with the new rig and drilling speeds were judged faster on two locations where depths up to 13,000 feet were reached. Maximum drilling depth is well beyond 17,000 feet.

Why Diesel-Electric?

Grey Wolf saw two distinct advantages: Diesel-Electric would adapt readily to present components, thus reduce costs; and because components are connected by flexible electric cables, the rig could be broken into skid-mounted packages for fast transport and quick rig-up.

Why Electro-Motive Power?

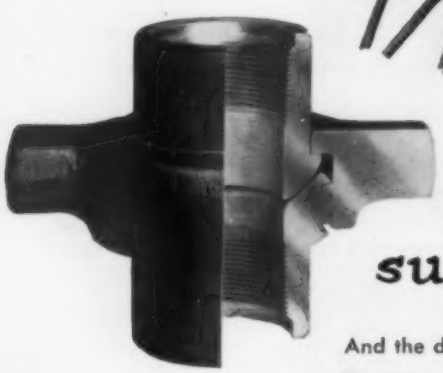
A "packaged" system was one reason Grey Wolf decided on Electro-Motive Power. For this system is designed and built to work together—one manufacturer—one source of responsibility. Other reasons were the accurate control and torque characteristics of Electro-Motive Power plus its demonstrated economies of long life and low maintenance on both land and offshore rigs.

Have you considered the advantages of Diesel-Electric for your drilling operations? Contact your Electro-Motive Representative for complete details.

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS · La Grange, Ill.
In Canada: General Motors Diesel Limited, London, Ontario
Petroleum Industry Sales Offices: Dallas and Houston, Texas; Morgan City, Louisiana; Los Angeles, California.

View from derrick floor shows simple arrangement of components on ground. Single 625-hp dc electric motors drive mud pumps. Electric cables run from generating units to various motors on overhead runways. Flexible cables permit placing equipment to fit location conditions.

Driller's control stand provides maximum visibility for every operation. Simple, sensitive controls provide smooth and rapid acceleration of loads with positive control of speed and torque. From this one panel, driller has complete control of all Diesel-Electric equipment.



"I didn't realize there was such a difference in unions!"

And the difference is quite obvious when you compare Weco with other unions.

To start with—Weco's exclusive ball and cone seat design gives you the most perfect sealing possible. The spherical surface of the male sub seats on the conical surface of the female sub forming a positive, leak-proof seal. The sturdier construction of Weco Unions takes the most punishing service as part of a regular day's work. The Acme threads permit faster, easier make-up and break-out, day after day, without damage or distortion.

These differences in the design and construction of Weco Unions pay dividends in longer life and superior sealing service.

Ask for Weco Unions at supply stores everywhere. They are available in the exact size and pressure required for all oil country connections.

U-8-56

WECO®

WELL EQUIPMENT MFG. CORP.

HOUSTON, TEXAS

Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

fmc

Helpful Answers to Caustic Questions

As a leading supplier of Caustic Soda, Columbia-Southern is asked many questions each month about this versatile "workhorse" alkali. While the answers probably are not completely new to every Caustic user, they do re-emphasize certain basic points that shouldn't be forgotten. We hope that you will find this series interesting and helpfully informative.

In how many different forms does Caustic come?

The four commonest forms of Caustic are anhydrous solid and flake (available in several particle sizes), and liquid concentrations of 50% and 73% strengths.

How can I determine my most economical Caustic buy?

So much depends on individual processing requirements that any flat answer might be misleading. The most important cost factors for your consideration are the purchase price of the material, transportation costs, unloading costs, labor costs for process handling, and investment cost of equipment required for unloading, storage and process handling. In general, equipment for handling solid or flake Caustic will be least costly, that required for 50% liquor next, and the equipment for handling 73% more expensive. Handling costs per ton of NaOH, however, will be in exactly the reverse order.

A more thorough way to get a clear cost picture of the best Caustic for your needs is to contact Columbia-Southern for the prompt services of our experienced Caustic Soda specialists. Just call, write or wire our Pittsburgh address . . . at no obligation, of course.

Is Caustic dangerous to handle?

Like most other chemicals, Caustic merits proper respect. Shipping improvements like the tank car dome platform (first standardized for all Caustic shipments by Columbia-Southern) have made unloading and initial handling much safer than in the past. As an elementary precaution, fast-valve showers and eye fountains should be readily accessible to all personnel who might come into contact with Caustic. Columbia-Southern will be happy to mail you copies of our up-to-date booklet, *Unloading and Handling Caustic Soda.* This handbook covers in detail such basic points as use of proper protective clothing, inspection of storage and piping facilities, tank car handling, steaming and dissolving procedures, complete stocking of First Aid cabinets, and the like.

Has Caustic Soda been used for a long time?

Caustic has one of the longest chemical pedigrees known. Various authorities agree in placing its earliest use among the Egyptians, who used the alkali in making cleansers. These ancient peoples produced Caustic, or lye, by utilizing the action of lime on solutions of plant ash sodas. Causticizing was effected cold, in the presence of a small amount of water, with the lye gradually separated by filtration through a cloth.

Is there more than one basic method of producing Caustic Soda today?

Yes. In the most popular electrolytic method, an electric current is passed through a sodium chloride brine solution contained in specially designed cells. Chlorine gas forms at the cell's anode, and a Caustic Soda solution collects at the cathode. This low concentration liquor is evaporated to yield the various commercial concentrations desired. The older lime-soda method of manufacture, not far removed in theory from the Egyptian process, utilizes the treatment of a soda ash solution with slaked lime. The resulting chemical reaction produces a weak Caustic Soda solution and a precipitate of Calcium Carbonate, which is filtered out. As in the electrolytic method, the Caustic solution is evaporated and purified to obtain commercial concentrations.

BIG SPLASH SAVES CUSTOMERS' DOLLARS. Advanced-design Columbia-Southern barges like the big beauty below carry Caustic along inland waterways, do a better job of protecting cargo purity, and unload more quickly and easily. Can you accept economical water delivery?

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte • Chicago
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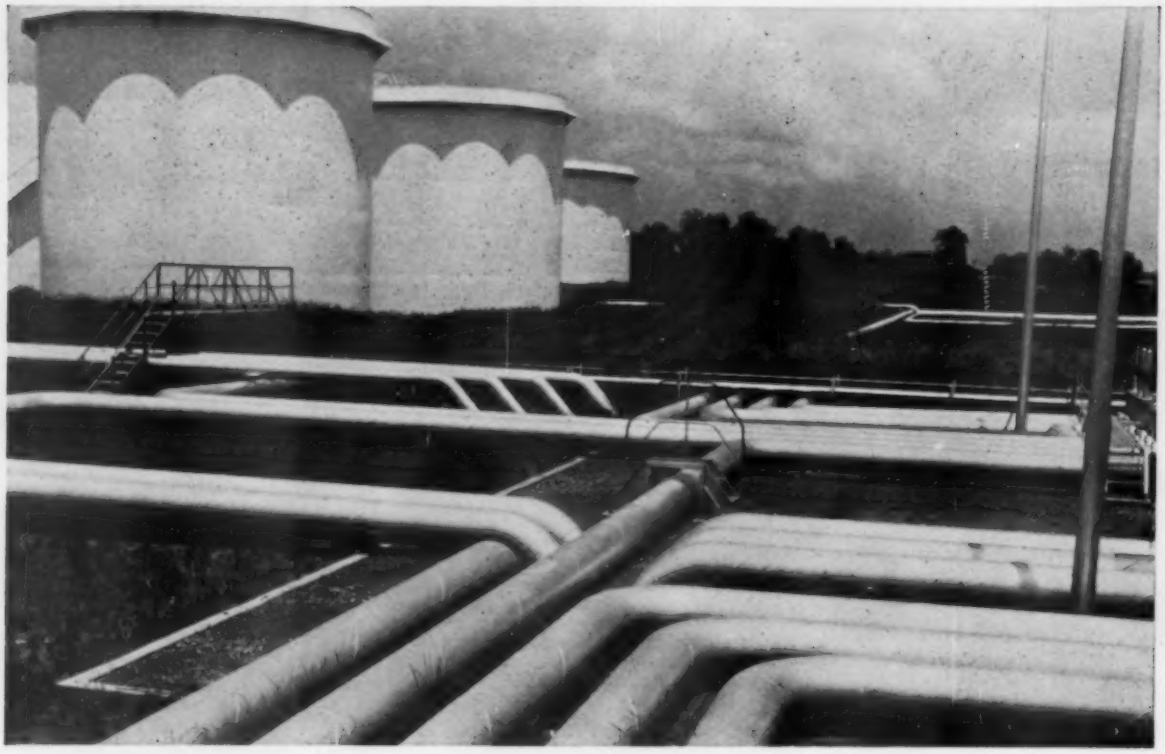


ARMCO WELDED STEEL PIPE SAVES YOU MONEY 3 WAYS

LONG, UNIFORM LENGTHS

Uniform lengths, up to 50 feet without a circumferential weld, mean fewer joints, faster assembly, and easy, accurate computation of joints required.

CHOICE OF 20 DIAMETERS

Wide range of diameters makes it unnecessary to buy more capacity than is needed.

CHOICE OF 10 WALL THICKNESSES

You can select the correct wall thickness for the job without buying costly excess metal.

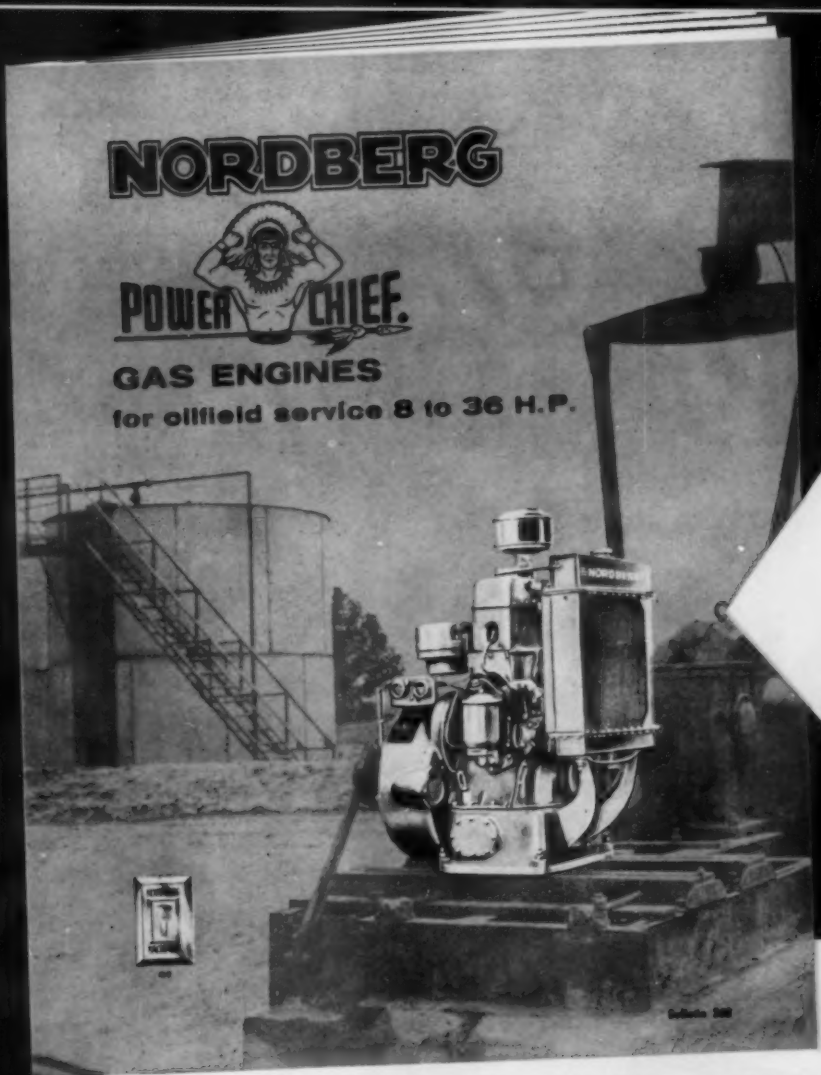
* * * *

Write for more data. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 4847 Curtis Street, Middletown, Ohio. 201 KOME Building, Tulsa, Oklahoma. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

Where Armco Pipe is used in the Oil and Gas Industries

1. **Natural Gas and Natural Gasoline Divisions**
   a. Gas gathering lines
   b. Natural gasoline plant piping
   c. Residue gas lines
   d. Gas transmission lines
2. **Oil Refining Division**
   a. Stock lines
   b. Low pressure steam lines
   c. Vapor collection lines
   d. Waste product lines
3. **Oil Producing Division**
   a. Casing
   b. Oil lines
4. **Miscellaneous uses (all divisions)**
   a. Conduit or casing pipe
   b. Pipe piles, pile shells
   c. Water well casing
   d. Water supply lines
   e. Cooling water systems

ARMCO WELDED STEEL PIPE



10 REASONS WHY YOU SHOULD USE NORDBERG *POWER-CHIEF*® OIL FIELD ENGINES

Throughout the oilfields, Nordberg Power Chief Gas engines are consistently compiling records for reliability and low maintenance costs . . . records that in many cases show more than 40,000 hours of continuous operation with original rings, valves, liners, bearings, piston and crankshaft still in place.

Listed at the right are 10 of the reasons behind the outstanding performance of Power Chief Gas engines in 'round-the-clock oilfield service. For the *complete* story, send for your copy of the all-new Bulletin 268 illustrated above.

1. CONSERVATIVE RATINGS
2. OPERATE ON SOUR GAS
3. SMOOTH, STEADY OPERATION
4. WEATHERPROOF
5. SAFEST ENGINE IN THE FIELD
6. EASY STARTING
7. MORE "EXTRAS" AS STANDARD EQUIPMENT
8. EASY TO SERVICE
9. PARTS AND SERVICE READILY AVAILABLE
10. QUALITY CONSTRUCTION THROUGHOUT

NORDBERG MFG. CO., Milwaukee, Wisconsin

NORDBERG
POWER CHIEF
DIESEL and GAS ENGINES

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AVAILABLE AT YOUR LOCAL SUPPLY STORE — OR CONTACT THESE AUTHORIZED DISTRIBUTORS:

FRED E. COOPER, INC., Tulsa, Oklahoma
BRANCHES: Houston, Odessa, Olney
SALES & SERVICE: Casper, Wyo.; Corpus Christi, Longview & Wichita Falls, Texas; Lafayette, La.; Wichita, Kansas.

IN-MAR CO., Wilmington, California

STEPHENS OIL FIELD REPAIR, Fairfield, Illinois

MEAD ENGINE & WELDING WORKS, Sterling, Kansas

CORNELISON ENGINE MAINTENANCE CO., INC.
Seminole, Oklahoma

ROGERS DIESEL ENGINEERING CO., New Orleans, La.

Announcing

DaVi

... sons' antioxidants

Announcing Davison's antioxidants . . . Dav-Ad 101 . . . Dav-Ad 102!

Davison, long the leading catalyst supplier, offers these antioxidants to the refining industry . . . Dav-Ad 101 and Dav-Ad 102.

These antioxidants offer more advantages than other types for use in motor gasoline and aviation gasoline, as well as turbine oils, transformer oils, lubricating oils, jet fuels, synthetic lubricants, various plastics, rubber, industrial fats and oils, asphalt tile and waxes.

Davison maintains a staff of technical personnel complete with laboratory facilities available for consultation and assistance on inhibitor or treating problems.

Write for specifications, samples and prices.

Dav-Ad 101 available in 100 pound fiber drums . . . Dav-Ad 102 available in 55 gallon steel drums containing 400 pounds net or in tank car lots. Stocks are located at Baltimore, Md., Lake Charles, La. and Cincinnati, Ohio for your convenience.

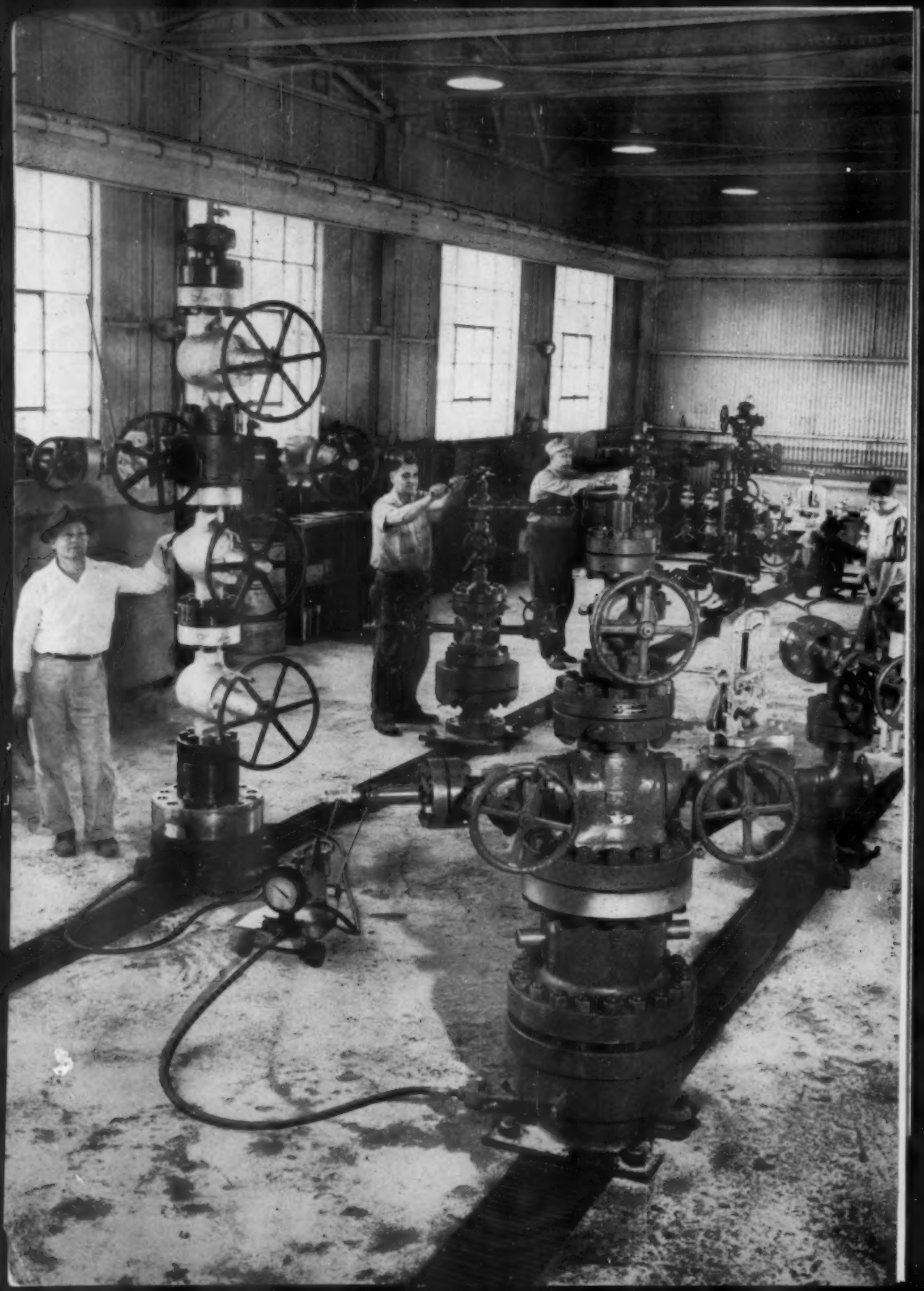
Progress Through Chemistry

DAVISON CHEMICAL COMPANY

Division of W. R. Grace & Co.

Baltimore 3, Maryland

SALES OFFICES: Chicago, Ill.; Houston, Tex.; New York, N. Y.; Baltimore, Md.; San Francisco, Calif.; Tulsa, Okla.
In Canada: Davison Chemical Company Ltd., Toronto.



Proved, Then Proved Again

Costly time is lost, disaster invited when equipment fails in the field. Factory-assembled well control equipment must undergo rugged trials before it is exposed to the rigors of field conditions. It must be proven first in the shop to prove of value in the field.

At one time in the history of a certain tribe in Africa, a male didn't become a full-fledged warrior until he single-handedly killed a mature lion with his spear.

Even today in remote parts of the world, male members of tribes and clans must undergo rugged physical trials, sometimes excruciating pain, to prove their worthiness of wearing the mantle of adult responsibility.

Americans believe in testing, too. Of course, our way of life dictates that we place the emphasis on our "warriors" in a different way. But when they produce something—a new frozen food, an automobile, a rifle, a lawnmower, a BB gun or a new type of wellhead equipment—the product undergoes more rugged testing than any Cherokee brave ever encountered.

No Oil Center Tool Company machinist, engineer or field man has ever killed a lion single-handedly with a spear . . . although a few have popped off some wolves in West Texas and a couple of bull 'gators in South Louisiana.

But these men and their equipment run gauntlets all the time.

The gauntlets are problems encountered by companies and individuals who drill for oil and gas.

And one big reason why O-C-T equipment proves its mettle in the field is because the equipment is proven in the shop first.

O-C-T testing facilities in the Houston headquarters plant simulate field conditions.

That's why when you buy O-C-T you buy equipment that has been proven.

Testing is an important part of all-encompassing O-C-T service.

Whether it's a complete 30,000 pound test Tree, a casing or tubing head, flange, choke or gauge, O-C-T has its own gauntlet to prove the product's mettle.

That's why you install O-C-T equipment with an assurance it will work—for it has worked before.

O-C-T tests all the way down the line.

There are tests for new designs.

There are tests for equipment making its debut and for equipment that has been refurbished.

O-C-T is test conscious.

An O-C-T product goes out of the shop prepared and ready for the biggest test—the field test.

O·C·T

OIL CENTER TOOL CO.

Export Representatives: South America — East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

In Crowded Waterways . . .

RCA
CR-105B RADAR

. . . or Open Seas

For Safer Navigation — Accurate Position Finding

RCA CR-105B Small Boat Radar is the choice of workboat operators with an eye to all-around efficiency and top performance. Here's why:

Accuracy—a big, bright 10-inch scope provides sharp, detailed presentations ranging from 50 yards to one mile for close-in navigating . . . 2, 4, 12 and 32 mile ranges on the open sea. Sharp horizontal beam produces high resolution.

Compactness—space saving design ideal for small craft where space is always at a premium. Indicator requires only 2 square feet of deck space; antenna is lightweight.

Economy—low power drain plus 7 kw peak power means lower operating costs with no sacrifice in efficiency. And installation costs are less—no waveguide run necessary.

Ruggedness—completely watertight, built to last and last with the year-in, year-out quality performance found in all RCA Radars.

Simplicity—easy to read, easy to interpret, easy to service—easy for all hands to become proficient radar operators in a short period of time.

Let us send you free information on how RCA Small Boat Radar can help you get more efficiency at less cost in workboat operations.

RADIO CORPORATION OF AMERICA
RADIOMARINE PRODUCTS • 75 VARICK STREET, NEW YORK 13, N.Y.
Radiomarine
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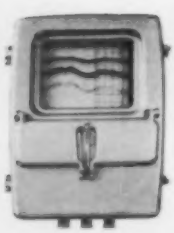
RCA "Workhorses" for the Workboat Fleet



RCA Depth Recorders are sensitive, accurate navigational instruments. Record depths, warn of rocks, wrecks, other underwater hazards.

Model LAZ-17

For use on all types of commercial vessels and larger pleasure craft, RCA Radiomarine VHF Model ET-8058 Radiotelephone equipment is designed for marine communications in the 148 to 174 mc band.

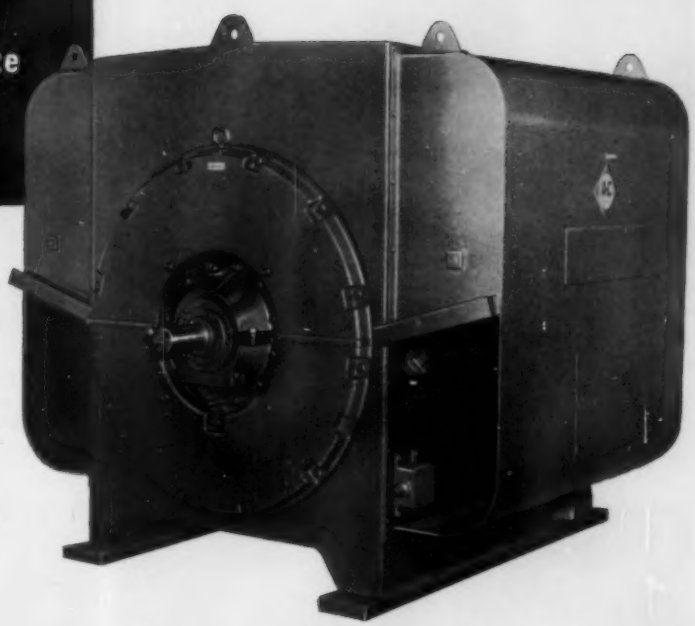
Model ET-8058

To keep you in touch with home port offices, other fleet units. With Model ET-8050 Radiotelephone you talk ship-to-shore, between ships; calling and distress frequency.

Model ET-8050

Eliminate costly enclosures with Allis-Chalmers weather-protected MOTORS

Modern features
cut operating, maintenance expense... give MORE dependability



Here's a newly designed line of Allis-Chalmers weather-protected motors with the ability to "take" outdoor conditions. This means no expensive protective enclosures are needed . . . a big saving in plant or installation building costs.

Designed to meet defined NEMA requirements, these motors incorporate many important features which assure dependable outdoor operation:

- **Ventilating System** — Low velocity intake, vertical lift, change of direction and high velocity discharge of ventilating air keep rain, snow, sleet, dust and dirt out of vital parts.
- **Removable Air Ducts** — To facilitate inspection and maintenance of interior air passages, air intake ducts are designed for quick removal.
- **Stator Assembly** — Removable as a unit, it simplifies maintenance and minimizes downtime.
- **Split Sleeve Bearings** — Capsulized design permits access to motor interior without disturbing the bearings or their enclosures. Positive vapor seal is used on high-speed motors. Antifriction bearings are available for slow speed motors.
- **Proven Insulation** — Famous Allis-Chalmers insulation systems (Class A and B) are available. And, for extreme temperatures, or where high resistancé to abrasion and moisture is required, Allis-Chalmers can provide the revolutionary *Silco-Flex* system.

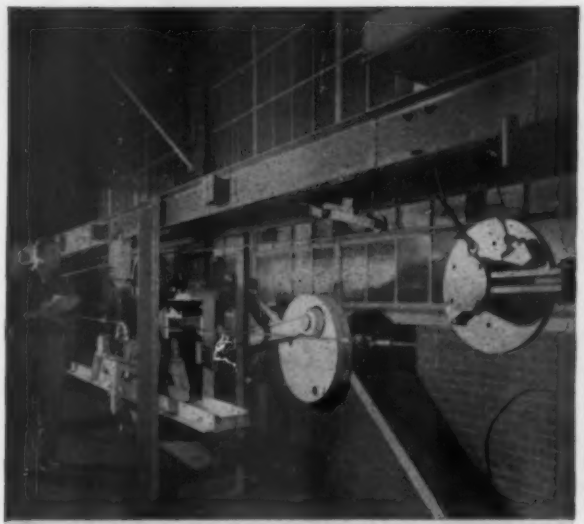
Silco-Flex is an Allis-Chalmers trademark.

THIS DESIGN available in ratings from 250 to 900 hp. Other designs in larger horsepower ratings are also available. Contact your A-C sales office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin. Ask for Bulletins 51B8606A and 05B7894.

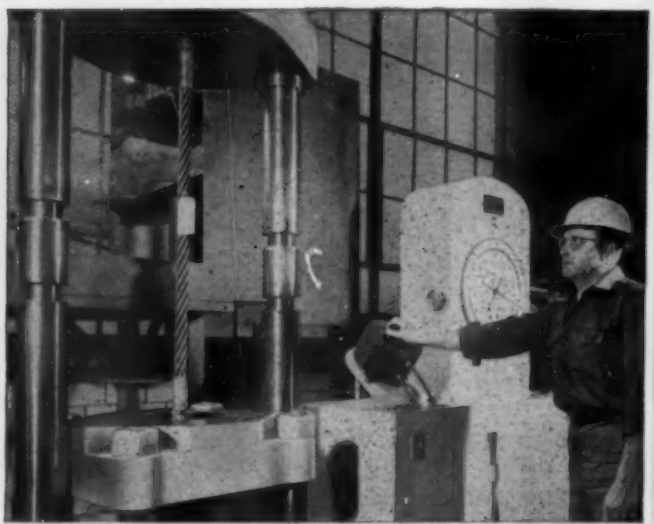
A-5292

ALLIS-CHALMERS

Why J&L wire rope service life



Fatigue machine. This 6 x 25 I.P.S. fiber core rope is being subjected to a continuous fatigue test to determine the number of reversed bends before breakage.



Cross-section tension test. This 1¼" 6 x 41 I.P.S.-RL fiber core rope was tested to 140,000 lbs. tensile load. Catalog requirement for same rope is only 123,000.

Vibration fatigue test subjects this boom pendant assembly to repeated shock loading. The 2,500 ft. lb. load provides action simulating actual field conditions.

Tension test of individual wires shows pounds of tensile load withstood before breaking. Every coil of wire used in J&L wire rope is thoroughly tested before acceptance.

salesmen can talk with confidence

To users and buyers of wire rope, safety and long rope life are all-important considerations. When you specify J&L, you can be confident you are buying wire rope that will stand up to the job for which it is made.

Every strand of J&L wire, every finished wire rope, is subjected to exacting tests to determine maximum factors of strength, flexibility, abrasion and corrosion resistance. This quality control is a most important operation in the production of J&L wire rope. Shown here are some of the tests that enable your J&L wire rope salesman to talk about quality with confidence.

The next time you buy wire rope, call your nearby J&L representative, or write direct to the Jones & Laughlin Steel Corporation, Wire Rope Division, Muncy, Pennsylvania.

J&L STEEL **Jones & Laughlin**
. . . a great name in steel

Torsion machine tests ductility by twisting wire. This 8" length of .081 wire took 41 revolutions before snapping. Federal standards require only 26 revolutions.

Wrap test. Galvanized wire is wound eight times around a mandrel of its own diameter and then unwrapped, proving ductility of wire and the bond of the coating.

(Protective screens removed during photography.)

NEW

ECCENTRIC DRIVE
Reduces bearing pressure. Pressure lubricated.

DOUBLE HELICAL GEARS
Provide smooth, quiet power transmission.

Gardner-Denver triplex pump puts more power on well service Trucks

This newly designed triplex plunger pump (PA-8K) enables you to mount *more power* on your trucks for more economical cementing, acidizing and fracturing operations—*while staying within load limits.*

The underslung jackshaft of this new pump makes these advantages possible. This more compact pump is more easily mounted, and the jackshaft is brought in closer connection with the truck's PTO. Power transmission is smoother and pumping operations more efficient.

Over-all size and weight are reduced—width: 57⅛" . . . length: 85⅞" . . . weight: 6350 lb. Write for complete details.

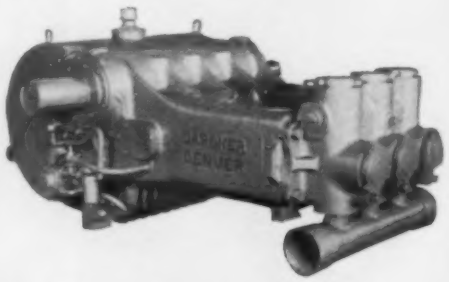
THREADED VALVE COVERS
Save on valve inspection time. Interchangeable.

SPECIAL SERVICE PLUNGERS
Available in various materials to meet service requirements.

Specifications for PA-8 and PA-8K Pumps

Pump	Jackshaft	4½" Plunger		4" Plunger	
r.p.m.	r.p.m.	g.p.m.	p.s.i.	g.p.m.	p.s.i.
175	825	290	1550	228	2000
150	705	248	1820	195	2300
125	587	207	2180	163	2750
100	470	165	2730	130	3470
75	352	124	3640	97	4650
50	235	83	5400	65	6950
34	160	56	8000	44	10000
Gal. per Rev.		1.65		1.31	

4½ x 8 triplex plunger pumps with upper jackshaft (PA-8) also are available.



ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois. In Canada: Gardner-Denver Company (Canada), Ltd., Toronto 16, Ontario. Gardner-Denver Export Division, 233 Broadway, New York, N. Y.
Oil Field Offices: Dallas, Houston, Tulsa, St. Louis, Los Angeles, New York, Pittsburgh, Denver, New Orleans, San Francisco, Kansas City, Winnipeg, Edmonton

Sour crude with an RVP of 8 is stored in 80,000-bbl. cone-roof tank. Turnover averages once a month. Crude is pumped in at 5-8000 bbl. per hour, pumped out at 2000 bbl. per hour. "Microballoon" Spheres were installed by the "foam aspirator" method two years ago and are still effective.

Evaporation loss cut

sixty percent for two years

with "Microballoon" spheres*

That's the total estimate for this tank at the Socony Mobil Paulsboro, N. J. Refinery. It is estimated that filling losses were cut 42.5 per cent, breathing losses 66 per cent.

Installed in May, 1955, the microscopic hollow spheres of BAKELITE Brand Phenolic Resins are judged to have paid for themselves in 15 months. They are still effective. Another instance of the proven performance of "Microballoon" spheres.

For the facts on this increasingly economical method of evaporation control, write Dept. XQ-128.

*Trade-Mark of The Standard Oil Co., (Ohio)

For evaporation control...

BAKELITE BRAND RESINS

BAKELITE COMPANY, *Division of Union Carbide Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC.

Why Our Customers Fit ROCKWELL-Nordstrom VALVES Into Their Operations...

ROCKWELL-Nordstrom valves have proved best for permanent installations because they are lubricant sealed for really positive shut-off.

Mid-Continent Customers prefer valves with design simplicity because fewer parts mean fewer repairs. ROCKWELL-Nordstrom valves, proven through 40 years of service in the industry, are built for longer life at low end cost. The original lubricated plug valve has features that have never been equaled . . . Positive Quarter-Turn Rotary Action . . . Unexposed Seats Eliminating Corrosion and Erosion . . . Ports Surrounded by Sealing Lubricant Film . . . Repackable under Pressure . . . These and many other reasons are why our customers call for ROCKWELL-Nordstrom valves. Contact your Mid-Continent representative for valves in complete sizes and pressure ratings. Mid-Continent stores, sales offices and representatives are located in all oil active areas.

Another Field-Proved Product Supplied by Mid-Continent

PESA

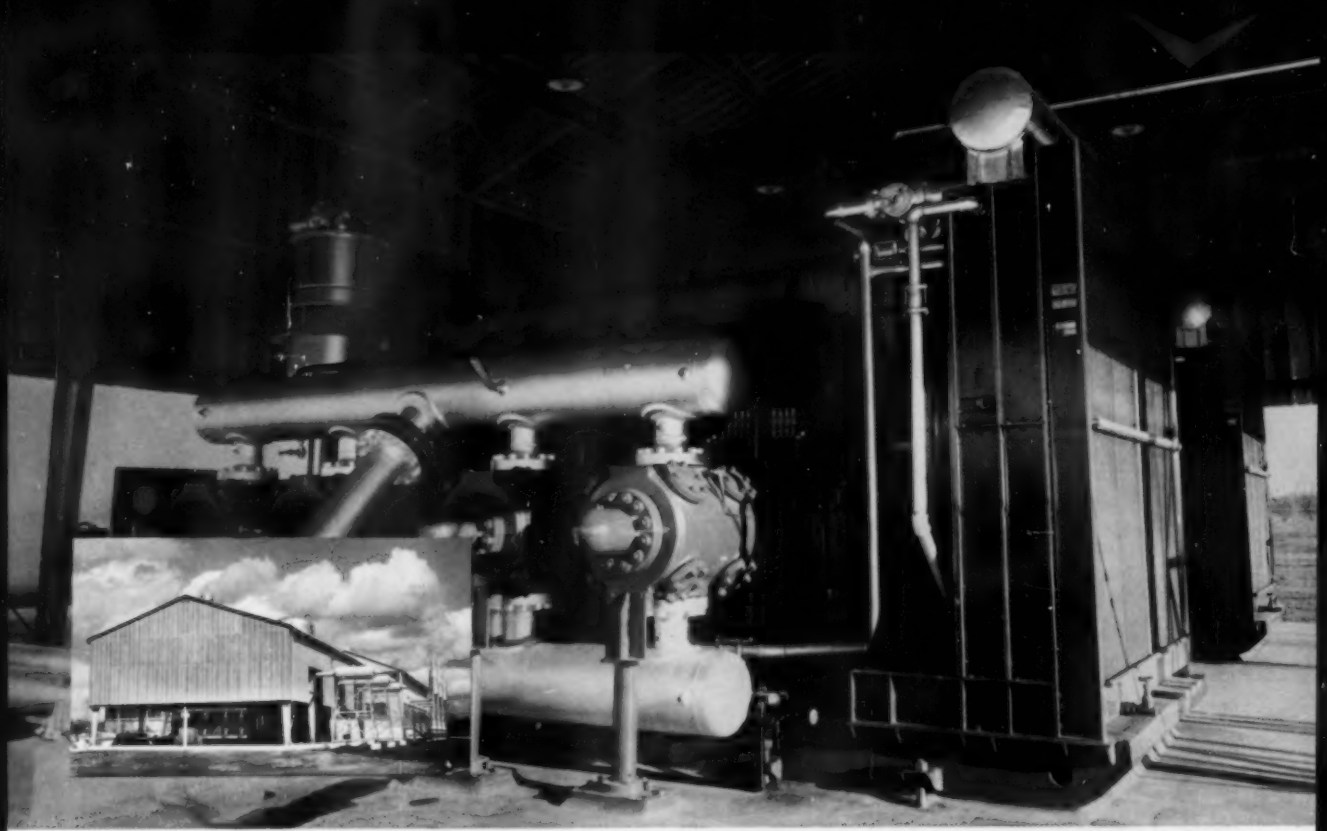
MID-CONTINENT Supply Company

MID-CONTINENT BLDG. • FORT WORTH, TEXAS

Export Division: 45 Rockefeller Plaza, New York 20, N. Y. Cable: MIDCUMPORT NYK

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

BEAIRD-INGERSOLL-RAND Packaged Compressor Plant



SOUTHERN NATURAL GAS COMPANY's White Castle Supply Line Station, equipped with two Beaird-Ingersoll-Rand 10-SVG, 550 h.p. packaged compressors. Shown in inset is the Toca station where three 12SVG, 660 h.p. Beaird packaged compressors have been installed to supplement three large stationary units. Other sizes available from 120 to 660 h.p.

Economical Expansion —

PACKAGED UNITS ADDED TO STATIONARY COMPRESSOR INSTALLATION

SOUTHERN NATURAL GAS COMPANY's growing supply line systems are reaching toward the Gulf on both east and west sides of New Orleans. Pacing this expansion are two new packaged compressor installations boosting the increased gas volume to the main supply line station at Gwinville, Mississippi. The east side line is handled by the enlarged compressor station at Toca, Louisiana. Formerly equipped with three large stationary compressors, this plant has been expanded by adding three 12SVG 660 h.p. Beaird-Ingersoll-Rand packaged units. On the west line a new station at White Castle equipped with two 10SVG 550 h.p. units is offsetting the increased line pressure from Toca station and handling added gas volume.

Southern Natural selected packaged compressors for their expansion program as a result of their field experience. Package units have proved more flexible in service, were more economical to install, required less foundation work and when no longer needed can be almost wholly salvaged. Packaged compressor equipped stations have also been found to be easier and more economical to design for future horsepower additions.

Let us show you how economically Beaird-Ingersoll-Rand packaged compressor plants can be added to your compressor station.

BEAIRD
another AMF product
PACKAGED COMPRESSOR PLANTS

LOWEST COST PER HORSEPOWER INSTALLED

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana
A subsidiary of American Machine & Foundry Company

SHREVEPORT, LOUISIANA • *Sales Offices: Dallas, Houston, Corpus Christi and Midland, Texas • New Orleans, Louisiana • Tulsa, Oklahoma • Denver, Colorado Los Angeles, California • Caracas, Venezuela, and Cie. Ingersoll-Rand, Paris, France.*

"History demonstrates clearly that the material well-being of the people in any nation is closely related to their per capita consumption of energy. It is the energy of fuels which has made mass production possible—which has provided large-scale transportation—which is permitting millions of people today to have heat and cold at will in any climate. Certainly it has been the energy of fuels which has been the foundation of our own amazing growth as a nation."

—Eugene Holman, Chairman of the Board, Standard Oil Company (New Jersey)

ESSO 75 YEARS

producing energy for an abundant life

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

Say GASO and R-e-l-a-x

HUNDREDS OF PIPELINE PEOPLE DO

No question, no doubt, no uncertainty when you specify GASO Pumps. Their 42-year record is relaxing assurance of everything you look for in pumps—adaptability to the job, capacity performance and low, low upkeep for unbelievably long periods of time. We are as close to you as our nearest distributor.

Newest member of the Gaso family—Fig. 3466 Horizontal Triplex Pump. A rugged 4" stroke high speed single acting plunger pump for moderate capacity, medium-to-high pressure service.

DISTRIBUTORS

W. L. SOMNER COMPANY, Shreveport, Louisiana • Odessa, Texas • Tinsley, Mississippi • Brookhaven, Mississippi

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HAGUE EQUIPMENT CO., INC. Evansville, Indiana

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GASO PUMP & BURNER MFG. CO.
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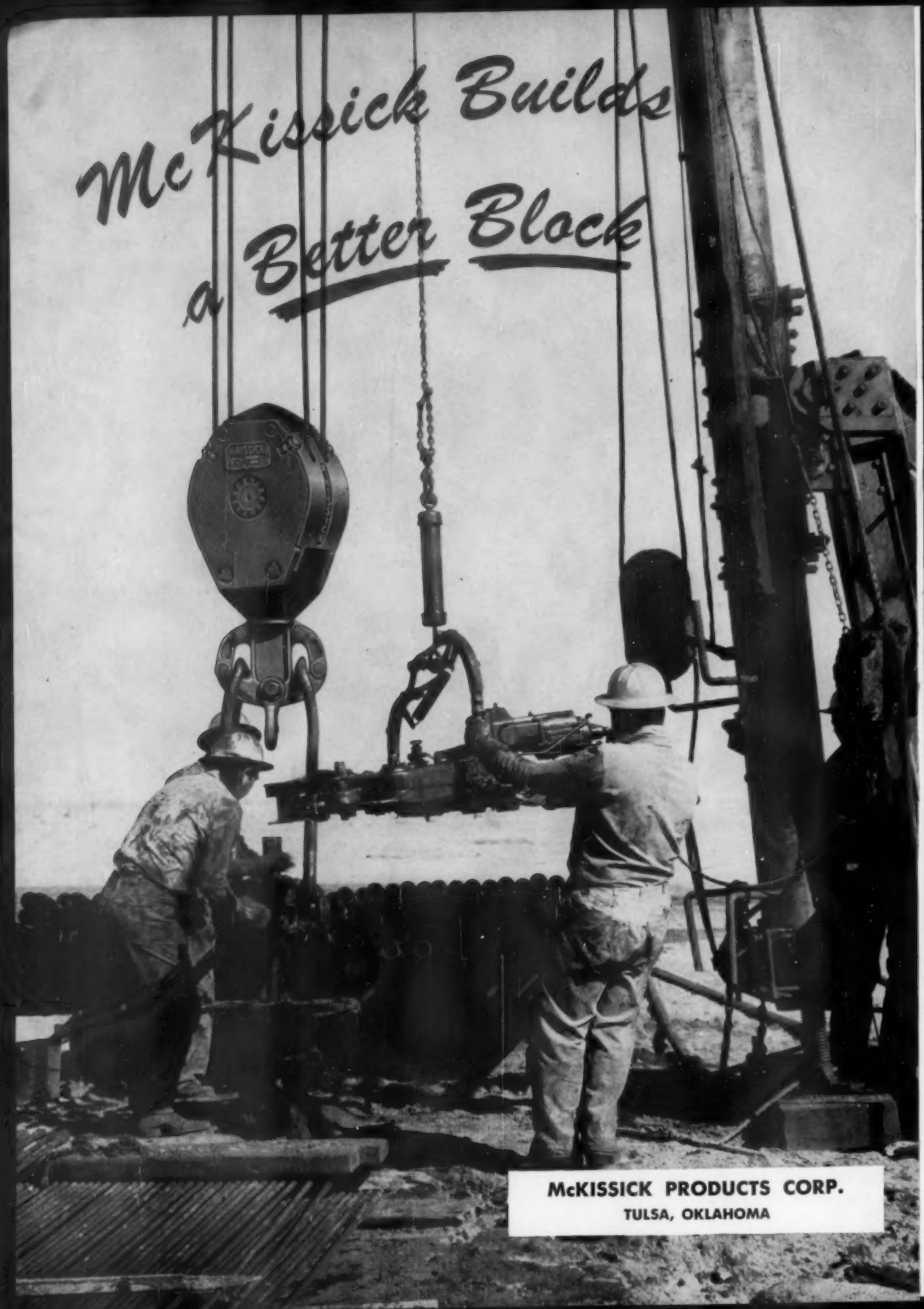
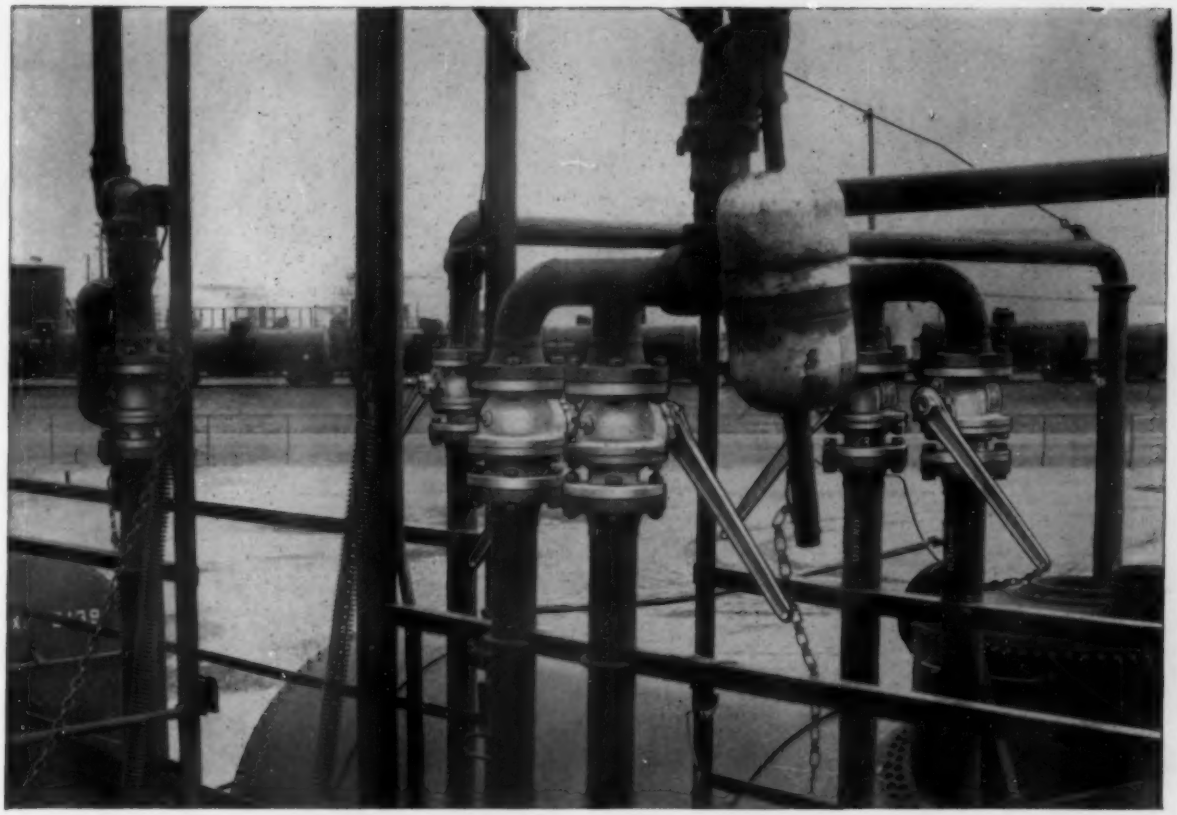
Export Office: 149 BROADWAY, NEW YORK

GASO PUMPS
for every oil industry need


McKissick Builds
a Better Block
McKISSICK PRODUCTS CORP.
TULSA, OKLAHOMA



He said leaking couldn't be stopped

...*but Rockwood Ball Valves stopped it!*

The resident engineer of a major oil company was skeptical when we told him about the exclusive features of Rockwood Ball Valves. It was impossible, he said, to keep racks free from messy oil conditions due to drippings from valves. But he agreed to replace his old style valves with Rockwood Valves.

He was surprised at the result — *absolutely no leaking from Rockwood Ball Valves.*

It's easy to see why Rockwood Ball Valves are leakproof when you examine them. You'll find—

Full Round Pipe Size Flow — no change in shape or volume of fluid stream — no turbulence — no minimum loss.

Quick Opening and Closing — only a quarter turn needed.

Longer wear resistance — Chrome-plated bronze ball withstands abrasion, pitting and scratching.

Leakproof Seal — pressure of fluid automatically positions ball against seat to form tight seal.

It works as good as it reads! Send coupon today for complete information. Rockwood Ball Valves come in all pipe sizes. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal industrial areas.

ROCKWOOD BALL VALVES

FULL, ROUND FLOW

ROCKWOOD SPRINKLER COMPANY
1272 Harlow Street
Worcester 5, Mass.

Send me illustrated folder V-4 on Rockwood Full-Flow Ball Valves.

Name.....

Title.....

Company.....

City.....Zone....State.....

Anaconda Arsenical Admiralty-439 Tubes being installed in the condenser at the Shippingport, Pa., Atomic Power Plant–25 miles northwest of Pittsburgh.

CONDENSER IN AMERICA'S FIRST BIG ATOM POWER PLANT USES 60 MILES OF ANACONDA ARSENICAL ADMIRALTY TUBE

The electric generating station at the Shippingport, Pa., Atomic Power Plant will add a maximum 100,000 kw of electric power capacity to Duquesne Light Company's system when it is placed in operation this year.

More significant, however, is its function of measuring the performance of the Pressurized-Water Reactor. It will help give some of the answers on how to "burn" uranium on a large scale and utilize the power economically, to guide design of future atomic power plants.

A SKETCH of The Shippingport Atomic Power Plant, cut away to show containment vessels housing the pressurized-water reactor and heat exchangers which generate steam to operate the turbine-generator. The condenser is located directly beneath the turbine-generator shown in the background.

The Westinghouse Turbine-generator has a minimum rating of 60 megawatts and a maximum of 100 megawatts. It operates on saturated steam at low pressure–987,350 lb/hr at a throttle pressure of 620 Psia, for 79.3 megawatt gross generator load. It is served by a 70,000-sq.-ft. Westinghouse condenser which provides a condenser vacuum of 1.5 in Hg Abs.

The condenser has a total of 10,276 Anaconda Arsenical Admiralty-439 tubes, 7/8" O.D. x 18 Stubs' gage x 30 ft. long, with a total weight of 153,676 lb. The tube plates of "true oval shape," 153" x 213" x 1½" thick, are of Leaded Muntz Metal, each weighing approximately 12,450 lb. These, too, were supplied by The American Brass Company.

Oil Refineries have virtually made Anaconda Arsenical Admiralty-439 standard for refinery condensers and heat exchangers handling crudes, rerun stocks, cracked products, lubricating oils, and by-products. It is resistant to dezincification and can handle corrosive waters at relatively high temperatures. It can also withstand sulfur compounds encountered in refining sour crudes.

The American Brass Company laboratories are constantly studying corrosion problems to help make condensers and heat exchangers give longer and more dependable service–are leaders in the development of alloys to help meet the problems. Arsenical Admiralty is but one of its many contributions in the field.

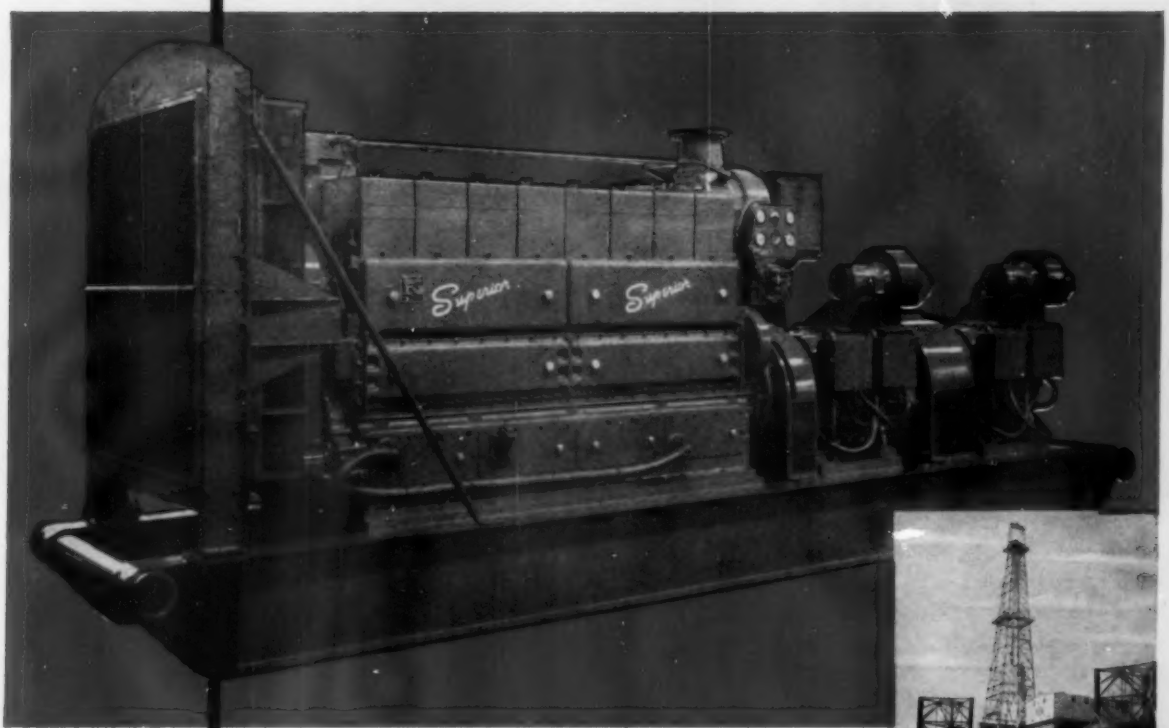
TECHNICAL SERVICE. The Technical Department of The American Brass Company will be glad to help you select the one best alloy for the conditions you face. For such special service or for information on Anaconda Tubes and Plates, write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 8784P

ANACONDA® **TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS**

MADE BY THE AMERICAN BRASS COMPANY

Dixilyn Drilling selects . . .

WHITE'S Superior Diesel-Electric



Lighter, extremely simple, more powerful drilling rig power plant!

Dixilyn Drilling Corporation of Odessa, Texas wisely chose White's Superior Diesel-Electric power for drilling operations to over 25,000 ft. deep from their LeTourneau mobile tripod platform, off the Louisiana Gulf Coast. The platform's 175 ft. spuds will permit drilling in approximately 105 ft. of water. The complete power package, including three 834 h.p. Superior engine-generator sets, will dependably provide a total of more than 2,500 h.p. From simplified controls, the driller can direct 2,000 h.p. to a National 1625 drawworks, or 2,000 h.p. to the mud pumps. Operational headquarters for the rig will be Morgan City, La.

More power for faster, deeper drilling—land or offshore, plus smoother overall performance, quicker response and extreme simplicity in arrangement and operation are the results of White's new important advancements and design refinements.

Components consist of 2 or more engine-generator sets, a minimum of 3 drive motors, and simple controls. White's well-known Superior oil field engine and rugged 300 to 550 kw generators in tandem make up an engine-generator set. Total weight of one set alone is almost 8 tons lighter than comparable units!

Power concentration in the heavy-duty drive motors also achieves simplicity, compactness and lighter weight. Largest drive motors are rated 1000 h.p. continuous and 1250 h.p. intermittently. This permits use of only one motor for the drawworks and one for each mud pump. Multiple motor linkages are unnecessary and controls are greatly simplified. All components are stocked, standard production items, ready for prompt delivery.

Get complete information from leading rig manufacturers, White's oil field representatives, or through White Diesel Engine Division.

White Diesel

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY

Plant and General Offices: Springfield, Ohio

Install it... then forget it!

Ball and seat of Kennametal* or Kentanium* stays *down* longer . . . cuts well downtime . . . keeps production high . . . profits *up*.

High hardness . . . extremely high resistance to wear, to corrosion, and to deformation under impact . . . Kennametal Balls and Seats stay on the job from 3 to 5 times longer than "special" or "super" alloys . . . 20 times the service of steel . . . even under the most severe conditions of ball pounding, ball-on-seat impact, sand abrasion, or acid corrosion. More oil is moved up . . . at a faster rate . . . and with fewer pump pulls, less oil well downtime. Pump repair and maintenance costs are cut.

Two grades are available. Kennametal grade KH is for use under high abrasive cutting conditions. Kentanium is recommended for use in applications where severe cage wear, corrosive sand, sulfide fluids, and seat impact are met. Kentanium, being one-third lighter than steel, greatly reduces ball-on-seat shock.

It will pay you to use Kennametal or Kentanium balls and seats to combat wear, impact failure and corrosion in your operations. For further information, contact your regular supplier, or write KENNAMETAL INC., Dept. OG, Latrobe, Pennsylvania.

*Trademarks

Let it pound away!

A Kennametal Ball and Seat provides exceptionally high resistance to:

. . . fluid cutting	. . . ball pounding
. . . wear	. . . ball-on-seat shock
. . . corrosion	. . . electrolytic action

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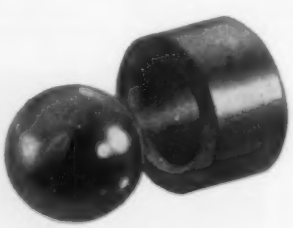
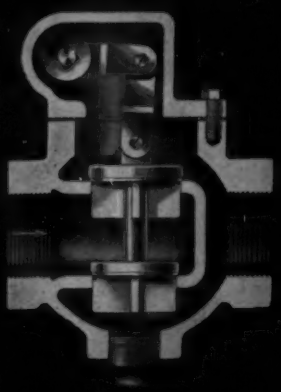


FISHER®

OIL PRODUCTION VALVES

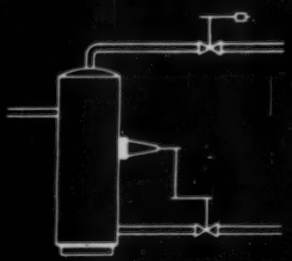
HERE'S JUST A FEW OF THE VALVES FISHER CAN PROVIDE FOR YOUR OIL PRODUCTION WORK—

GAS VALVE



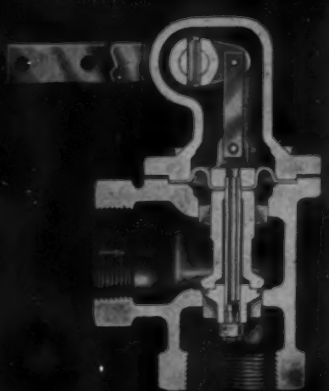
TYPE 9G—an economical and simple separator back pressure valve.

SIZES—Screwed 2", 3" and 4".
Flanged—3" and 4".



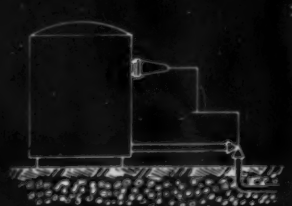
Low Pressure Separator Back Pressure Valve

OIL VALVE



TYPE 1907—for low pressure oil and gas separator. Also very successfully used as a water dump valve.

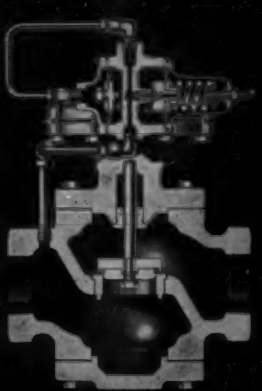
SIZES—Screwed 2" and 3".
Flanged—2", 3" and 4".



Water Dump Valve On Tank

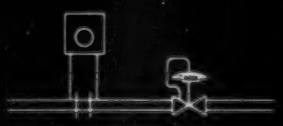
Separator Low Pressure Oil Valve

BACK PRESSURE VALVE

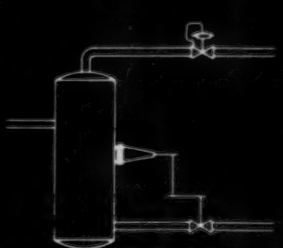


TYPE 63—here's a pilot operated valve that will give close regulation and tight shut-off.

SIZES—Screwed 2".
Flanged—3" and 4".



Field Back Pressure Valve



Separator Low Pressure Back Pressure Valve

FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA · WOODSTOCK, ONTARIO
LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

Holiday Detection is an important step in checking a coating job before it goes below ground. But it's *after* the line is laid that the real test of how well the coating material will withstand the attack of water and soil chemicals begins. That's why coal-tar enamel is used on most important pipelines: it has proved its ability to provide long-term protection of pipeline investment.

Concrete "Corrodes," Too, under the attack of acid or alkaline solutions. Sewer pipe made of concrete is especially subject to deterioration: that's why Hoboken, N. J. is having its new sewer line protected, inside and out, with two coats of Bitumastic Super Service Black.

New Bulletin describing the important role of protective coatings in preventing corrosion is available. Request your copy by coupon below.

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Pittsburgh 19, Pa.

Please send me "The Fight Against Corrosion."

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how to
CUT CORROSION LOSSES
a report by Koppers Company, Inc.

Number 10 of a series

Dr. W. F. Fair, Jr.
Corrosion Consultant

Since the security of a multi-million dollar investment is at stake, preventing corrosion in buried steel pipelines is extremely important. In this field the decisions made as to corrosion-prevention practice in the *design* phase are irrevocable—and can prove tremendously expensive if wrong.

* * *

Hot applied coal tar enamels have been traditionally the primary part of the protection system on pipelines. In recent years, cathodic protection has become widely accepted as a supplement to coatings.

Enamels must now be judged as much on their value as long-term insulating materials as on their ability to prevent corrosion.

* * *

The best clue to a coating's performance is its ability to resist penetration by water. It is this inherent characteristic that determines a coating material's performance underground, with or without supplementary cathodic protection. As a coating absorbs water, it provides a decreased resistance to the flow of electric current between pipe and soil which is part of the corrosion process. Ultimately, water absorption leads to coating deterioration, which exposes bare pipe. In conjunction with cathodic protection, the coating system's most important function is that of a long-lasting electrical insulator so that impressed current requirements are kept to a minimum. Here too, a coating system's resistance to water penetration determines its performance. Actual pipeline operating experience has shown that the cost differential between maintaining cathodic protection on well and poorly insulated lines can amount to hundreds of thousands of dollars yearly.

* * *

Independent laboratories and industrial researchers have expended considerable time and effort in determining water absorption rates of protective coatings. Long-term tests have demonstrated, without exception, that coal-tar enamels have the highest resistance to water absorption among protective coating materials commercially available today.

The key to a coating's ability to resist water absorption seems to depend on the inherent molecular structure of the base material. The relative performance of a number of coatings in these various tests indicates that coating impermeability depends upon *aromatic content.* Coal tar enamel binders with an aromatic content in excess of 90%, show excellent water resistance in all tests while less aromatic materials show comparably poorer performance. Materials high in paraffinic content have been shown to leach under extended immersion.

* * *

An audio-visual meeting presentation discussing this important subject in detail is available. If you are interested in having a group-showing of this material—which includes a sound film—please address your inquiries to "How Long Should A Pipeline Last?," Koppers Bldg., Pittsburgh 19, Pa. or to Koppers District Offices: Boston, Chicago, Los Angeles, New York, Pittsburgh and Woodward, Ala. In Canada: Koppers Products, Ltd., Toronto, Ontario, and Edmonton, Alberta.

KOPPERS

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COATINGS AND ENAMELS

FIRST 500-ton Capacity Elevator!

FIRST 500-ton Capacity Spider!

FIRST Combination Elevator & Spider!

Introducing BJ's NEW 500-ton Elevator-Spider

This tremendous new tool serves as either a casing elevator or as a casing spider. Its 500-ton capacity gives it a super-strength grip for holding the heaviest string of casing ever run or contemplated. Yet it is so simple and so functional that it can be easily operated by one man. Interchangeable slip assemblies and inserts make it capable of handling all casing sizes from 4½" to 10¾". This 5000-pound giant is designed for the deep drilling operations of today and of the future.

Write for bulletin containing complete specifications.

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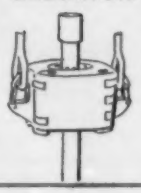
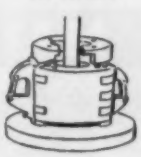


USED AS A SPIDER



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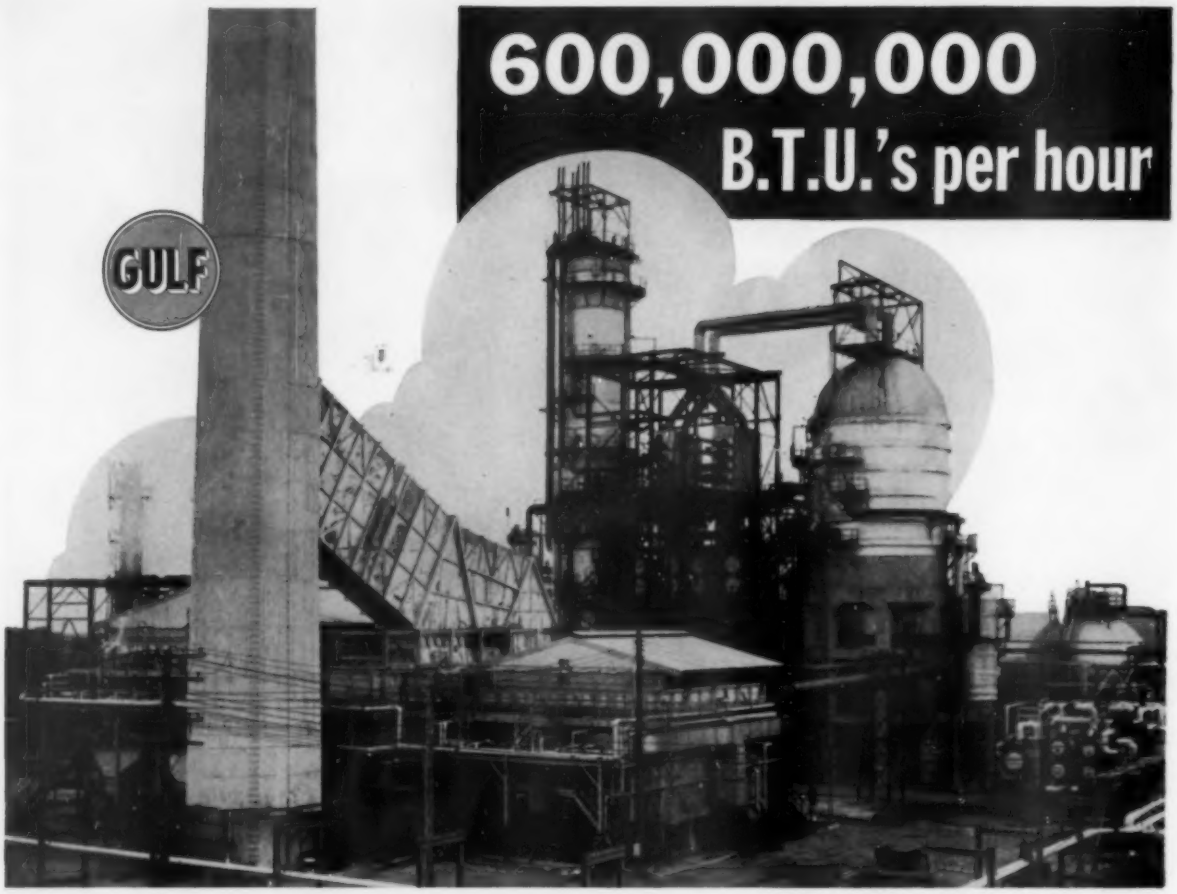

Forty-eight NATIONAL AIROIL Tandem Units fire Gulf's huge Crude Heater at Philadelphia.

with NATIONAL AIROIL'S *Exclusive* TANDEM COMBUSTION UNITS

This tremendous Combination Atmospheric—Vacuum Crude Heater at Gulf Oil Corporation's Philadelphia Refinery, was constructed by Foster Wheeler Corporation... for a total burner liberation of up to 600,000,000 B.T.U.'s per hour.

NATIONAL AIROIL *exclusive* Tandem Combustion Units achieve this capacity with maximum economy and availability.

These NATIONAL AIROIL oil burners are *all-alloy* for burning high temperature pitch separately, or in conjunction with non-aerated gas burners. Additional burners are also provided for waste gas disposal.

NATIONAL AIROIL Tandem Units are recognized as standard firing equipment in oil refinery and chemical plant heaters throughout the world. They are noted for versatility regarding fuels; and insure correct flame placement so necessary to avoid damage to the heat-absorbing tubes.

Your furnace maintenance problems are measurably reduced, and hours on stream greatly increased by use of Tandem Combustion Units.

Further information sent upon request on your letterhead.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes; STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

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• INDIVIDUAL FIRING OF SEVERAL GUN SECTIONS WITH JUST ONE RUN! Selective Rocket Jet . . . another first from Western Research . . . brings this new service to perforating.

For you, this means solution to such problems as . . .

- Completely selective perforating
- Pinpoint accuracy in blanket perforating
- Multiple zone perforating on a single run
- Many other applications impossible for conventional perforating

Flexibility of a tandem gun-section arrangement to meet any well conditions makes Selective Rocket Jet the most versatile perforating tool in the industry.

Custom rigging of gun sections in varying lengths in Selective Rocket Jet enables you to perforate several pay zones on one run, eliminates one-foot blanks between zones in blanket perforating, perforates eight-per-foot or more . . . all on a single run.

You save in rig and personnel time, and gain in accuracy and performance. *You* call the shots with Western's Selective Rocket Jet. Get all the advantages of Western engineering . . . get Selective Rocket Jet perforating. For radioactivity logging, jet perforating, fracturing and acidizing, *go Western* for ENGINEERED WELL SERVICES.

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High-pressure meter Model M-12. M Series meters for working pressures up to 1200 psi, 120 gpm.

Line meters. Model B-200, shown, has capacity of 3000 bbl/hr. New Model B-700 — 10,000 bbl/hr.

High-pressure meter Model D-35. D-Series meters for working pressures up to 600 psi, capacity 350 gpm.

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for uninterrupted high flow and sustained accuracy

RIGHT! to the LAST drop

The day you install A. O. Smith high-pressure meters is the day you start to gain. A. O. Smith meters help safeguard against loss in production, processing and delivery because they're as close to being foolproof as modern science can make them.

With A. O. Smith meters on the line — anywhere from wellsite to service station—you can be sure of accuracy that gives you readings "right to the last drop."

Why not see for yourself. Get in touch with your representative or write direct for comprehensive details.

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This seal on an air-compressor spells SAFETY from lubricant-caused fires and explosions

If you are operating one, ten or fifty air compressors in your plant, here's big news for you. The day of lubricant-caused compressor fires and explosions is *over!*

Now there's a new chemically tailored compressor lubricant called Pydraul AC that not only lubricates like a premium-grade petroleum oil—*it's fire-resistant!*

You'll realize additional savings in Pydraul AC's ability to minimize carbon deposits on air-compressor exhaust valves and air piping systems.

No conversion problems—just drain your flammable lubricant and replace with fire-resistant Pydraul AC—it's that easy.

Service-proved—two years of industry-wide service have confirmed Pydraul AC's *safety* and operating economies for power plants, gas transmission, chemical processing and the basic metalworking industry.

There's a fire-resistant Pydraul for every industrial hydraulic job: general-purpose Pydraul F-9; Pydraul 150 and Pydraul 60 for use in precision equipment; and Pydraul 600 for heavy equipment.

Pydraul: Reg. U.S. Pat. Off.

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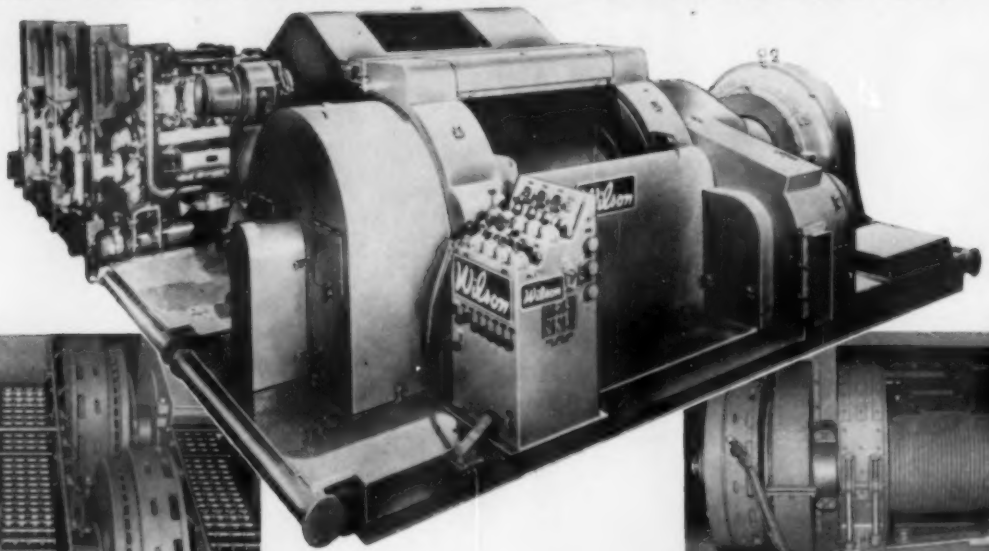
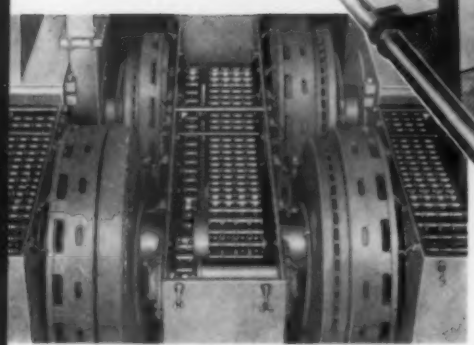
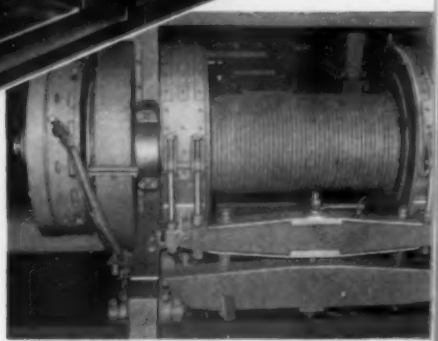
THE WILSON SUPER TITAN "66" OIL BATH RIG





CHAIN DRIVE, FOUR SPEED TRANSMISSION



NEW FRONT EQUALIZER BEAM TYPE BRAKE

A. Transmission has four air-tube friction disc clutches, all chain driven.

B. Transmission clutches easily capable of handling 3,000 horsepower, faster and smoother.

C. Main clutches outside drum — for ready accessibility!

D. World's largest effective Brake Ring surface!

E. Smoothest Brakes of any comparable rig.

F. Only one type of air-clutch throughout.

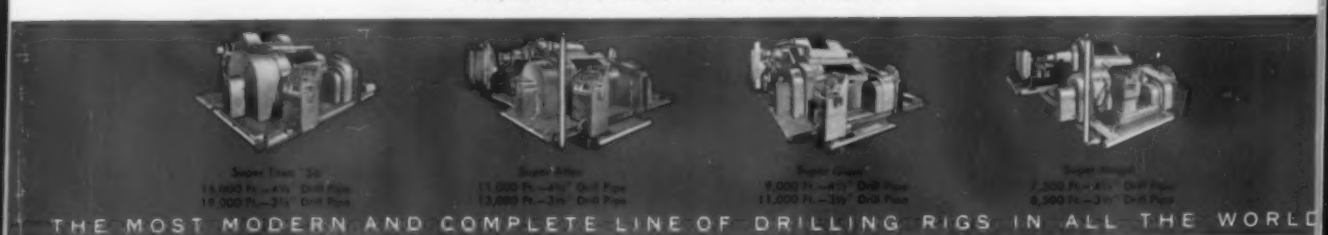
RATED DEPTH CAPACITY:

- 22,000 Ft. with 4½" Drill Pipe
- 25,000 Ft. with 3½" Drill Pipe

RATED POWER CAPACITY:

- Direct Drive—2,000 HP
- With Fluid Couplings—2,400 HP
- With Torque Converter—3,000 HP

WRITE FOR OUR NEW CATALOG NO. 257



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The Home of RED IRON

SUDDEN DEATH TO OIL FIRES!

Kidde wheeled units make short work of any blaze!

"One-man fire engines" are what some people call Kidde mobile fire extinguishing units . . . and with good reason! With one or two Kidde mobile units near large-scale fire hazards, there's no waiting fretfully for the fire department when fire strikes . . . you *are* the fire department!

Especially effective in fighting fires in oil, gasoline or other flammable liquids, Kidde *dry chemical* wheeled units have an on-off control *at the nozzle* (for easier operation) will give either "straight" or "fan" pattern for greater range or wider coverage. Designed for fast, easy maneuvering, Kidde *indoor* dry chemical "fire engines" pass readily through doorways with no costly waste motion, while *outdoor* models have wider-faced wheels for faster action on soft ground surfaces.

Kidde mobile fire extinguishing units are also available in CO_2 and foam types – illustrated and described below. For more information, call your nearest Kidde agent (he's in the yellow pages) or write today for Kidde's P-8 catalog.

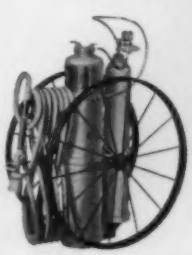
40-GALLON FOAM UNITS

Ideal protection against flammable liquid fires, delivering more than ten times its tank capacity in fire-smothering foam. 50 feet of hose, 50-60 foot effective range.

CO_2 WHEELED UNITS

Available in 50, 75 and 100-pound single-cylinder capacities. Shut-off valve located at nozzle gives operator complete control. Especially good indoors since CO_2 gas leaves no mess to clean up after a fire.

150-POUND DRY CHEMICAL UNITS



Single-lever control for "on," "off," "fan" or "straight" discharge pattern. 30-40 foot range on straight discharge. 50 feet of hose. Easily handled by inexperienced operator.

Kidde (K Kidde)

Walter Kidde & Company, Inc., 554 Main Street, Belleville 9, N. J.

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PENROD LAND AND SEA DRILLING COMPANY

DU PONT *Petroleum Chemicals* NEWS

One of a Series of Bulletins for the Petroleum Industry

MAY 1957

NEW DIRECTOR OF SALES FOR PETROLEUM CHEMICALS

W. SAM CARPENTER, III, has been appointed to succeed David H. Conklin as director of sales of the DuPont Petroleum Chemicals Division. Mr. Carpenter was promoted to this position from that of assistant director of sales.

Mr. Conklin has been named managing director of the DuPont Company (United Kingdom) Limited. He plans to make his home in London next year.

Alfred R. Mullis, formerly Eastern regional manager of the Petroleum Chemicals Division, replaces Mr. Carpenter as assistant director of sales.

Mr. Carpenter came to the Petroleum Chemicals Division in 1955 from the Cellulosics Division of the Textile Fibers Department where he was director of manufacturing. Prior to joining Textile Fibers, he had been manager of the DuPont Industrial Engineering Division. He joined the DuPont Company in 1938 as an industrial engineer.

In 1944 and 1945, he was active in the construction and operation of the government's atomic energy project at Hanford, Washington. Mr. Carpenter received his chemical engineering degree from Princeton University.

Mr. Conklin, who came to DuPont as a sales-service representative from Ingersoll-Rand, has been with the Petroleum Chemicals Division since it was organized. He was promoted to West Coast regional manager, then to sales pro-

OVER

Refiners can use these marketing services profitably

The DuPont Petroleum Chemicals Division offers a wide range of marketing aids and services. Many of these are ideal for dealer meeting programs. Others can be profitably used in promotion campaigns. Here is a brief résumé of the DuPont marketing services now available to you:

MOVIES available from DuPont make ideal program material for your dealer meetings.

"When the customer says 'KNOCK'" is a DuPont sponsored, full-color motion picture to instruct dealers on how to handle, in a salesmanlike way, customer complaints about gasoline quality.

This is but one of a series of films. They cover subjects ranging from gasoline quality, just mentioned, to an explanation of the benefits to the public of the percentage depletion allowance. Folders describing these films in detail, along with information on borrowing them, can be obtained from any of our sales offices.

Special demonstration equipment

To help refiners explain quality features of their products clearly and graphically, we have designed and built a number of special demonstration devices. The latest is a machine for showing how carburetor icing occurs and can be prevented with DuPont dimethyl formamide.

I. T. Rosenlund is shown here operating the de-icing demonstration.

This equipment is ideal for pointing up convincingly your product-quality

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

DU PONT *Petroleum Chemicals* NEWS

Du Pont equipment and experience usually available to refiners

REFINER:

Yes, we anticipated that fuel injection systems in cars would raise some new problems in gasoline blending . . .

DU PONT REPRESENTATIVE:

That's right, and our Petroleum Laboratory has already been making road tests using special fuels in injection systems.

REFINER:

Is that so — then maybe you people already have some data we could use?

DU PONT REPRESENTATIVE:

We're accumulating it gradually. We have three fuel-injection cars in our Petroleum Lab.

REFINER:

Good! I hope we can get the results of your investigations.

DU PONT REPRESENTATIVE:

I'll see that you do. As our road tests develop further facts we'll keep you informed.

CONTINUED *Marketing Services*

features to dealer and customer groups.

We can also supply you with a great variety of booklets and visual presentations on gasoline and motor oil quality, customer relations, station services, and other subjects. You can obtain these in large quantities at cost, or at no charge if you'd like only a few copies.

Continuing market surveys

When planning promotion campaigns, you can make use of the findings of our several extensive surveys of customer buying habits and service station operations.

These cover such subjects as the factors influencing a dealer's success, why motorists buy the brands they do, how they select service stations, and which factors in gasoline-brand advertising influence them most.

A report on our latest — and perhaps most important — survey will be finished by mid-summer. The results will be made available to all marketing executives in the oil industry.

Public relations aids

Our newest presentation emphasizes the importance, to everyone, of the petroleum industry — "A 'Brief' Case for Business." It is a lightweight kit which enables you to tell a forceful public relations story in a dramatic way. This kit was conceived and developed by Du Pont and is made available to oil companies through the Oil Information Committee of API, or through your Du Pont representative.

You can probably save time and money by supplementing your own promotion program with these useful aids, adapting them to your own purposes. Any of our Petroleum Chemicals Division representatives or sales offices will be glad to give you more information on them.

continued middle next column

H. C. Thompson displays the "Brief" case public relations kit.

CONTINUED *New Director of Sales*

motion manager, later assistant director and then director of sales.

Conklin a Navy veteran

During World War II, Mr. Conklin as Commander U. S. Navy, was on active duty 5 years—most of the time in the North Atlantic. He was awarded the Order of the British Empire.

Mullis former sales representative

Alfred R. Mullis joined the Du Pont Company in 1947 as a sales representative in the Gulf Coast Region. He was appointed regional manager there in 1951. The following year he went to New York as Eastern regional manager.

After graduating from Rice Institute with a chemical engineering degree, Mr. Mullis was associated with the Humble Oil and Refining Company in research and development work. While an officer in the Navy from 1942 to 1946, he specialized in petroleum inspection work.

SALES OFFICES

Chicago 3—8 So. Michigan Ave. . . . RAndolph 6-8630
Cleveland 15—25 Prospect Ave. . . . SUperior 1-1363
Denver 2—510 Mile High Center Bldg. . AComa 2-2347
Houston 2—705 Bank of Commerce Bldg. . . . . CApitol 5-1151
Los Angeles 17—612 So. Flower St. . MAdison 5-1691
New York 20—1270 Ave. of the Americas . . . . . COlumbus 5-2342
Philadelphia 2—3 Penn Center Plaza . LOcust 8-3531
Pittsburgh 22—1 Gateway Center . . . ATlantic 1-2933
San Francisco 4—111 Sutter St. . . . EXbrook 2-6230
Seattle 3—4003 Aurora Ave. . . . . MElrose 6977
Tulsa 1—1811 So. Baltimore Ave. . . . . LUther 5-5578
In Canada—Du Pont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, Toronto 12—Ontario . . . . . HUdson 1-6461
In Other Countries—Petroleum Chemicals Division, Export Sales, 7496 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

DU PONT
REG. U. S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

A-4310

Printed in U. S. A.

75 Years of Progress

A world-wide organization ready to serve you

In May, 1882, Mahlon E. Layne drilled his first water well, thus beginning an organization that would become world-wide and world-famous. He designed the Layne Vertical Turbine Pump, Layne Shutter Screen and Layne Gravel Wall Well. These are recognized today for their combined unfailing performance in producing water for the world.

Layne has always accepted the challenge of leadership. Engineering advances and research have guided our organization from the beginning. This is the pattern which has earned Layne the reputation for world-wide leadership. We owe this leadership to the trust our valued customers have placed in our organization.

Call on your nearest Layne Associate Company

DOMESTIC

LAYNE-ARKANSAS COMPANY
Stuttgart, Arkansas

LAYNE-ATLANTIC COMPANY
Norfolk, Virginia

LAYNE-CENTRAL COMPANY
Memphis, Tennessee

INTERNATIONAL WATER CORPORATION
Pittsburgh, Pennsylvania

LAYNE-LOUISIANA COMPANY
Lake Charles, Louisiana

LOUISIANA WELL COMPANY
Monroe, Louisiana

LAYNE-MINNESOTA COMPANY
Minneapolis, Minnesota

LAYNE-NEW YORK COMPANY
Linden, New Jersey

LAYNE-NORTHERN COMPANY
Mishawaka, Indiana

LAYNE-NORTHWEST COMPANY
Milwaukee, Wisconsin

THE LAYNE OHIO COMPANY
Columbus, Ohio

LAYNE-PACIFIC, INC.
Seattle, Washington

LAYNE TEXAS COMPANY, INC.
Houston, Texas

LAYNE-WESTERN COMPANY
Kansas City, Missouri

GENERAL FILTER COMPANY
Ames, Iowa

FOREIGN

INTERNATIONAL WATER SUPPLY, Ltd., London, Ontario, Canada
SOCIETE FRANCAISE de FORAGES (Layne France Cie.) Paris, France
CIA. ARGENTINA PRODUCTORA de AGUA S.R., Ltda., Buenos Aires, Argentina
LAYNE VENEZUELA C.A., Caracas, Venezuela
L'HYDRAULIQUE-AFRIQUE, Beyrouth, Lebanon
L'HYDRAULIQUE-ASIE, Paris, France-Saigon, Indo-China

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Kearney, Nebraska

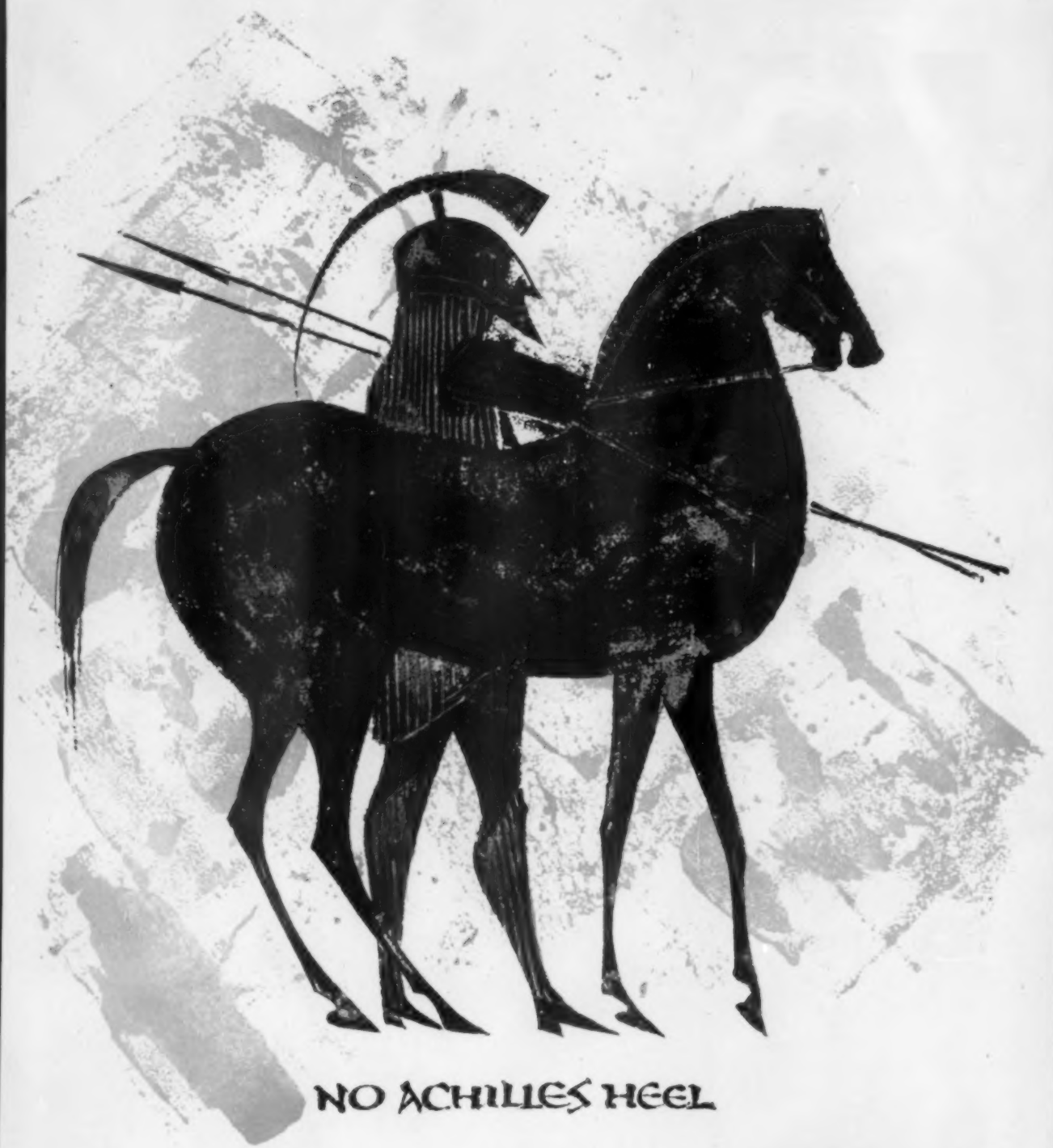
LAYNE MANUFACTURING COMPANY
Doud, Texas

1882 — 1957
Layne
75 YEARS OF PROGRESS

LAYNE & BOWLER, INC. MEMPHIS

General Offices and Factory • Memphis 8, Tennessee

WATER WELLS • VERTICAL TURBINE PUMPS • WATER TREATMENT



NO ACHILLES HEEL

From the sad story of Achilles, who was protected completely except for his heel, comes a valid moral. Protection to be completely effective must be total. Since 1939, Tube-Kote has been perfecting coatings and the techniques of their application to make positive protection. You can be certain of a thorough job, with no Achilles heel, when you specify Tube-Kote for corrosion protection.

TUBE-KOTE

SERVICE MARK REG. U. S. PAT. OFF.

PREVENT CORROSION,

Paraffin Deposits on Tubing, Casing, Drill Pipe, Line Pipe, and Sucker Rods

TK-2 is the only baked-on plastic lining obtainable which is backed by the company that developed and pioneered the use of plastic linings for oil field tubular goods and well equipment. No other type plastic can match the exceptional quality you get with TK-2 linings.

TK-2 is Tube-Kote's exclusive formula for phenol-formaldehyde plastic resin – the only type of plastic being used to line oil field equipment that positively will not soften under elevated temperatures. This means that TK-2 maintains its high degree of resistance to abrasion and tool gouging throughout any range of working temperatures. Such resistance to damage is not possible with air-dried or ordinary baked coating.

TK-2 STANDARD KOTE – TO COMBAT CORROSION. This is a lining that resists both corrosion damage and paraffin deposition.

TK-2 SPECIAL KOTE – TO COMBAT PARAFFIN DEPOSITION. This is an application to prevent paraffin accumulation, although it is not recommended for anti-corrosion use.

Enlarged cross-section of metal which has been coated with TK-2. This shows the close bond that exists between TK-2 and the metal surface. Because of its composition and the unique method of application, TK-2 flows into the most minute surface irregularities. When the final bake is completed, the multiple-layers of plastic coating become fused into an exceptionally strong mirror-smooth finish.

Tube-Kote
INCORPORATED
2727 HOLMES ROAD
P. O. BOX 20037
HOUSTON, TEXAS

They Say—

"Gasoline Retailer" support

Dear Sir:

I do not know how to thank you for your heartening letter of April 18 with the excellent editorial from The Oil and Gas Journal (April 22, page 75). You are indeed a friend and I appreciate your courage in electing to stand by The Gasoline Retailer and myself in our difficulties.

That it all turned out all right is just an accident because until 5 minutes before I was questioned, I did not know the real charges against me and my publication.

Thank you again for your support.

H. A. Inness Brown
Publisher
The Gasoline Retailer.

What does Ike pay?

The President goofed. Hope you will help correct this error. See page 79, Oil and Gas Journal, April 22.

Harold W. Springborn
Gas Age.

President Erred on Own Gas Rate

"Gas men, like all other Americans, have respected the privacy of the President's life at his Gettysburg farm. But these facts should be on the record.

"Manufacturers Light and Heat Co., part of the Columbia System, serves natural gas in Gettysburg. The President's farm is known to use natural gas for heating, water heating, cooking and perhaps other services.

"The published rate of Manufacturers service in the Gettysburg area for heating customers is, briefly, $3.00 for the first M.c.f. and an average of 72 cents thereafter. The company has applied for a 50-cent increase in the first step.

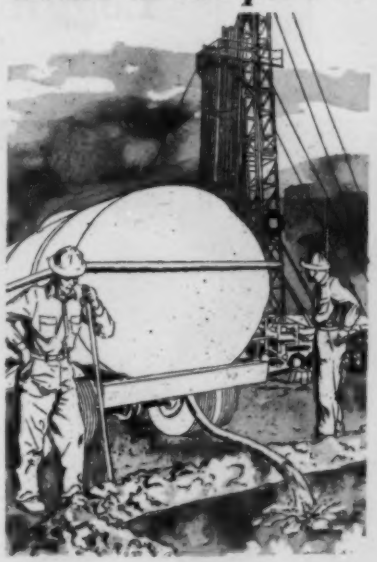
"Estimating the probable consumption at the farm, the average rate would not exceed 75 cents per M.c.f."

Gas Age, May 2, 1957.

Federal power off balance?

". . . This is what Harris (Rep. Oren Harris, D-Ark.) had to say about his new bill: 'When the Natural Gas Act of 1938 was passed there was no thought or intention of controlling producers of natural gas, and therefore no method of procedure was included by which such controls would be effectuated . . . The Supreme Court held in

Brine in the pit . . .



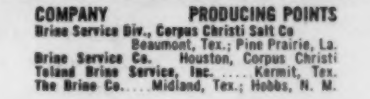
Like money in the bank

Super-saturated brine will save you hundreds of dollars in workovers, completions, and drilling through salt sections.

Brine is about one-third the cost of drilling muds. Drilling salt sections with brine guarantees a bit size hole, thus saving hundreds of dollars on cement jobs. So when you use Ready-Made brine it's almost like putting money in the bank.

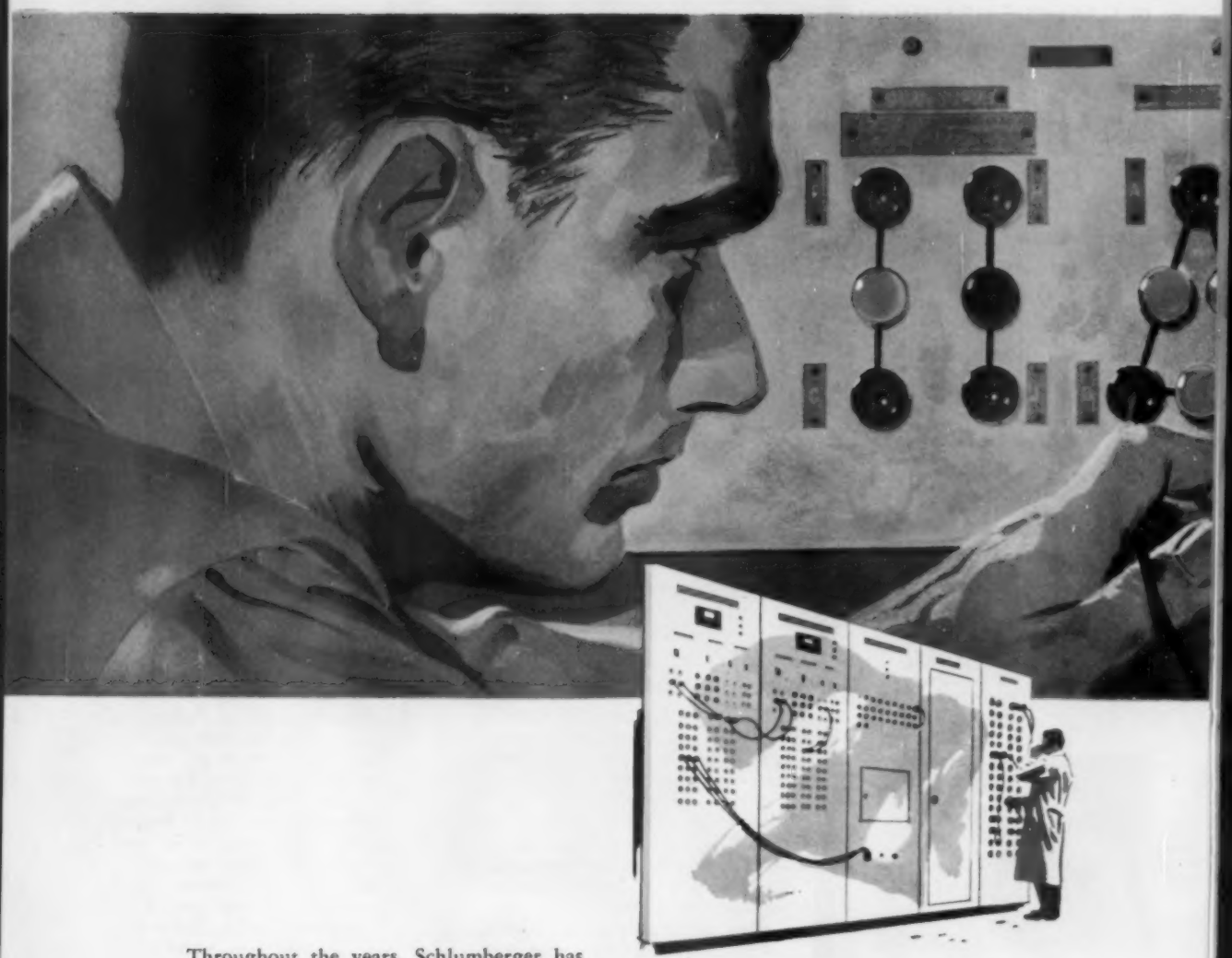
Delivered directly to your location by tank truck, Ready-Made brine saves time and money in handling and, unlike field water, Ready-Made brine is crystal clear and pure. Free of suspended solids, brine will not hydrate or water-block bentonitic producing zones. It makes your completion much easier—much cheaper.

Call the ABI brine company nearest you. You'll get three hour service wherever you are. Also write or call an ABI company for information about brine's industrial uses.



COMPANY	PRODUCING POINTS
Brine Service Div., Corpus Christi Salt Co	Beaumont, Tex.; Pine Prairie, La.
Brine Service Co.	Houston, Corpus Christi
Toland Brine Service, Inc.	Kermit, Tex.
The Brine Co.	Midland, Tex.; Hobbs, N. M.

Logging Through A Switchboard!



Throughout the years, Schlumberger has maintained leadership in the development of better oil-finding tools.

Recent notable developments include—

The Combination-Induction Electrical Log

The Formation Tester

The Capsule-Jet

These services . . . which are helping you find oil today . . . were the switchboard experiments of yesterday.

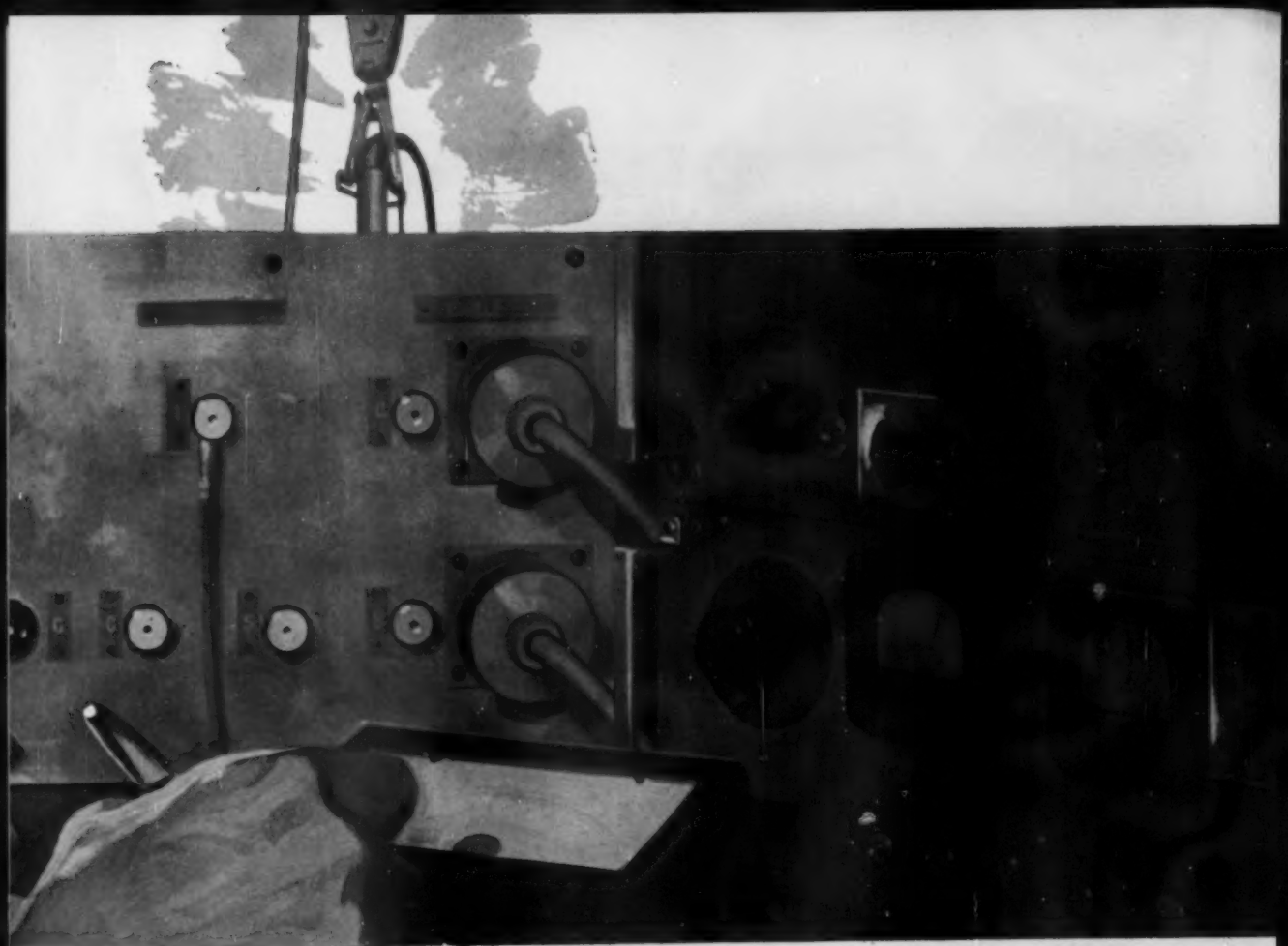
You cannot lower an idea into a well—it's a long way from original ideas for improved logging methods to practical field applications.

The carrying out of a concept means the design of an instrument that will withstand the shocks, pressures, and temperatures encountered in a bore hole . . . and still deliver precise information.

To aid in this work, engineers at the Schlumberger plant in Houston conduct simulated field tests from their laboratory benches. Each laboratory is wired to a common test well with standard logging cable. A "flick of the switch" in a distribution center connects the logging instrument in the well with the surface recording equipment in the laboratory. This "logging through a switchboard" illustrates the progressive engineering practices utilized at Schlumberger.

SCHLUMBERGER

Well Surveying Corporation



SCHLUMBERGER . . . Engineering for Better Service

Let me tell you what MY boss thinks about...

J&L HIGH-STRENGTH CASING

We're drilling in off-shore and other deep-formation areas, so I hear a lot at the office these days about high-strength casing.

I'll tell you what MY boss thinks about J&L's N-80 and P-110.

First, he wants top strength pipe, and he likes J&L's method of heating the pipe and quenching with high-pressure injector-type nozzles.

Second, he likes the scientific accuracy with which J&L then tempers the casing to make it uniformly tough and ductile.

Third, and he says most important of all, he likes the co-operation he gets from J&L Supply men especially informed on high-strength tubular goods — men who have complete technical data on J&L seamless and can be really helpful, as in designing special casing strings.

J&L SEAMLESS CASING: Sizes from 4½" to 13⅜" O. D. Ranges 2 and 3. Grades H-40, J-55, N-80, and P-110. T & C with API threads. Buttress Thread and Extreme Line Joints also available.

J&L SEAMLESS TUBING: Sizes from 2⅜" to 4½" O. D. in T & C. Non-upset or external upset. Integral joint in 2⅜" and 2⅞" O. D. in grades J-55, N-80, and P-105.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

J&L — A GREAT NAME IN STEEL

32-S-2

1954, contrary to legislative history and the intent of Congress, that the prices paid to producers of natural gas were subject to this act, and thus federal regulation. Since this concept seems to be the national policy, it is essential that a workable plan for regulation be provided.'

". . . The new Harris bill . . . is another case of abandonment by the legislative branch of our government of a historic power, and, if Congress accepts the Harris bill, Congress will be meekly submitting to the usurpation.

"Harris said federal control 'seems to be the national policy.' But the making of this policy is a legislative, not a judicial function. For a number of years, the executive and judicial branches have been assuming legislative powers, weakening the third branch and violating the constitutional balance of powers set up by the founding fathers.

"Unless Congress shows more fortitude than it has, this country is going to be run by executive and judicial decree."

Editorial in the Houston Chronicle.

Debating free-for-all

"Recently some Texas independent producers have been suggesting that a little squabbling is a good thing for the oil industry. When we fight among ourselves, they say, we destroy the ancient myth that the oil industry is in the hands of a monopoly . . .

"But it's altogether too easy to go overboard on that point of view. California and Proposition 4 presented a painful case in point. Here was an honest difference of viewpoints. . .

"The issue could and should have been debated publicly . . . But both sides of the debate should have been careful to keep their tempers well in hand.

". . . The most important thing that happened was that everyone in the industry . . . came out with a black eye to end all black eyes . . . They practically convinced the public that there wasn't a man of honor in the whole blamed and blasted industry . . . They almost invited the Government to step in and put the whole kit and caboodle under tight regulation.

"There are uncomfortable signs that the same thing could happen in the battle over imports.

"Some domestic interests haven't been content with just making the strong case that's there to be made against too great reliance on foreign oil. They've gone beyond that to make some charges against the patriotism and the integrity of the companies with foreign holdings. They've called motives into question, and they've made some slash-

Now, cost-conscious engineers are standardizing on **DARCOVA PUMCUPS!**

Reason—On all types of air and hydraulic controls and mechanisms maximum volumetric efficiency is assured with Darcova Pumcups. Moreover, Pumcups outlast ordinary packing at least 3 to 1!

CHECK THESE OTHER ADVANTAGES TOO!

- Reduced operating speeds
- Fewer shutdowns
- Smoother operation
- Lower power costs
- Longer cylinder life
- Closer control

If your slippage is showing, write for Bulletin No. 5503 on Darcova Pumcups for reciprocating pumps and air and hydraulic mechanisms.

DARLING VALVE & MANUFACTURING CO.
Williamsport 1, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
PUMCUPS

D
No matter how you figure . . . Davison's catalysts give you more!
• Davison gives you quality
• Davison gives you service
• Davison's high stability catalysts save you dollars.
That's why Refinery Men know that when they buy Davison they buy dependability in service and product.
DAVISON CHEMICAL COMPANY
Division of W. R. Grace & Co.
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Sales Offices: Chicago, Ill.; Houston, Texas; New York, N. Y.; Baltimore, Md.; San Francisco, Calif.
In Canada: Davison Chemical Company Ltd., Toronto
Producers of: Catalysts, Inorganic Acids, Superphosphates, Triple Superphosphates, Phosphate Rock, Silica Gels and Silicofluorides.
Sole Producers of DAVCO® Granulated Fertilizers.
W. R. GRACE & CO.

ing attacks on the character of the companies they oppose . . . Too often they've seemed inclined to forget the big distinction between arguing your own case and smearing the opposition's . . . They're piling up ammunition that can be used by our enemies . . ."

B. L. Majewski, president, Great American Oil Co., in a speech before the Independent Petroleum Association of America.

Taxes up, incentive down

"If we and our industrial associates are forced to direct our research into channels where the commercial results can be profitable in spite of the high tax bracket, we will obviously have to turn our backs on much that we are now doing. This is not a gap that can be filled by smaller enterprises, and the result will inevitably be a slowing down of technological progress and a longer and perhaps even endless trip to those bright horizons that technology has to offer.

". . . In my opinion, diminishing incentive is the most critical long-range problem of business today and, by corollary, of the nation itself. The big things, the worthwhile things in this country have always been the result of an extra effort, of something a little beyond expectations. To expect that extra effort when incentive is lacking is to cast human nature into a new and unfamiliar mold."

Crawford H. Greenewalt, president, E. I. du Pont de Nemours & Co., in a speech before the Economic Club of New York.

Oil's investment abroad

"Considerably more than half of all postwar investments abroad by private American companies have been made by the oil industry in exploration, and in production, refining, sales and marketing facilities. The program has been tremendous. . . "

T. S. Petersen, president, Standard Oil Co. of California, in a speech before the Society for the Advancement of Management, Dallas chapter.

Down the river for votes

"It is not enough to demand of our senators and congressmen that they support what may easily seem to them to be only our special interests. . .

"If all of us in all industry demand of our senators and congressmen that they fight for and support principles which preserve freedom and free enterprise we would then have a right to hope that these public servants would be with us in a common fight to save our country—and thus our free in-

DRAFTING TRENDS

"L" angle table cuts fatigue, speeds drafting

The year 1956 saw the introduction of a drafting table destined to change the working habits of many draftsmen. Made by the Hamilton Manufacturing Company and distributed by POST, it is the result of years of experimentation into methods of decreasing drafting fatigue and increasing productivity.

Designed as an "L" this new unit has a complete reference area at a right angle to the drawing board (see photo). Unlike many table arrangements in which the draftsman must turn around completely, or leave his board altogether, the new table *consolidates* the entire working area—the reference desk is never more than a slight turn from the board. This arrangement conserves a surprising amount of time and motion.

Reference desk is 28" x 60" and contains 3 drawers. Board is available in sizes 26" x 40" and 36" x 48".

Like Hamilton's *Auto-Shift* table, the new "L" table adjusts easily and quickly. A hand trip permits slope adjustments to any angle from vertical to horizontal. Another release frees the board for height adjustment through a range of 8". These convenient adjustments are easy to operate and step up efficiency. Where semi-privacy and other unique advantages are needed, the "L" angle table's versatility is especially desirable.

Another motion-saver: "Boardmaster" drafting machine

While very helpful on the board, many drafting machines have characteristics which almost nullify their value—blind spots, awkwardly placed controls, slippage in control settings, etc.

The Universal "Boardmaster" drafting machine solves many of these problems. Its overarm construction allows complete visibility of the protractor at all times. The controls are all *centrally located*—conveniently placed for manipulation by two fingers.

The indexing control has a push-button action that provides automatic indexing every 15°. The vernier clamp has an ingenious double wing lever for locking intermediate angle settings.

Aside from operating ease, the "Boardmaster" meets the highest standards for accuracy. No other drafting machine can match its precision and easy operation.

Further information on these items is available from the Reader Service Division of Frederick Post Company, 3644 N. Avondale Avenue, Chicago 18.

POST

SENSITIZED PAPERS & CLOTHS • TRACING & DRAWING MEDIUMS • DRAWING INSTRUMENTS & SLIDE RULES
ENGINEERING EQUIPMENT & DRAFTING SUPPLIES • FIELD EQUIPMENT & DRAFTING FURNITURE

Otis Runs
Special Sub-Surface Tools, Too.

dustry. . . We have in the past sold our country down the river for votes for our special interest legislation."

J. R. Butler, Butler, Miller & Lents, Houston, in a speech before the Independent Petroleum Association of America.

CALENDAR OF EVENTS

MAY

13-16 American Petroleum Institute, division of refining, midyear meeting. Sheraton Hotel, Philadelphia.

13-17 American Petroleum Institute, safety and fire protection committees, Hotel President, Kansas City.

14-16 American Petroleum Institute, central committee on highway transportation, Cosmopolitan Hotel, Denver.

14-16 Industrial Nuclear Technology Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology and Nucleonics Magazine, Museum of Science and Industry, Chicago.

16-17 American Right of Way Association, third annual national seminar, Conrad Hilton Hotel, Chicago.

16-17 American Petroleum Institute, division of production, Pacific Coast district meeting, Hotel Biltmore, Los Angeles.

16-18 Geological Society of America, southeastern section, annual meeting, Morgantown, W. Va.

19-22 Texas Independent Producers and Royalty Owners Association, Galvez and Buccaneer Hotel, Galveston, Tex.

20-22 American Petroleum Institute, division of transportation, central committee on transportation by water and tanker corrosion symposium, San Francisco.

20-22 American Gas Association, chemical, engineering, and manufactured gas production conference, Balmoral Hotel, Bal Harbour, Fla.

20-23 American Society of Mechanical Engineers, twenty-ninth annual conference and exhibit of the oil and gas power division, Kentucky Hotel, Louisville, Ky.

21-23 Pennsylvania Gas Association, annual meeting, Pocono Manor Inn, Pocono Manor, Pa.

22-24 American Association of Oilwell Drilling Contractors, conference for drilling executives, Houston.

23-24 Kentucky Oil and Gas Association, annual membership meeting, Hotel Phoenix, Lexington, Ky.

23-24 American Institute of Mining, Metallurgical, and Petroleum Engineers, third annual joint meeting, Rocky Mountain petroleum sections, Northern Hotel, Billings, Mont.

23-24 Western Petroleum Refiners Association, southwest regional technical-industrial relations meeting, Hotel Paso del Norte, El Paso, Tex.

27-29 Rocky Mountain Oil and Gas Association, twelfth annual convention, Denver.

29-31 Annual short course in gas technology, Texas College of Arts and Industries, Kingsville, Tex.

JUNE

3-5 Petroleum Electric Power Association, annual convention, Amarillo, Tex.

3-7 Oil-Heat Institute of America, thirty-fifth annual convention, Sheraton-Plaza Hotel, Boston.

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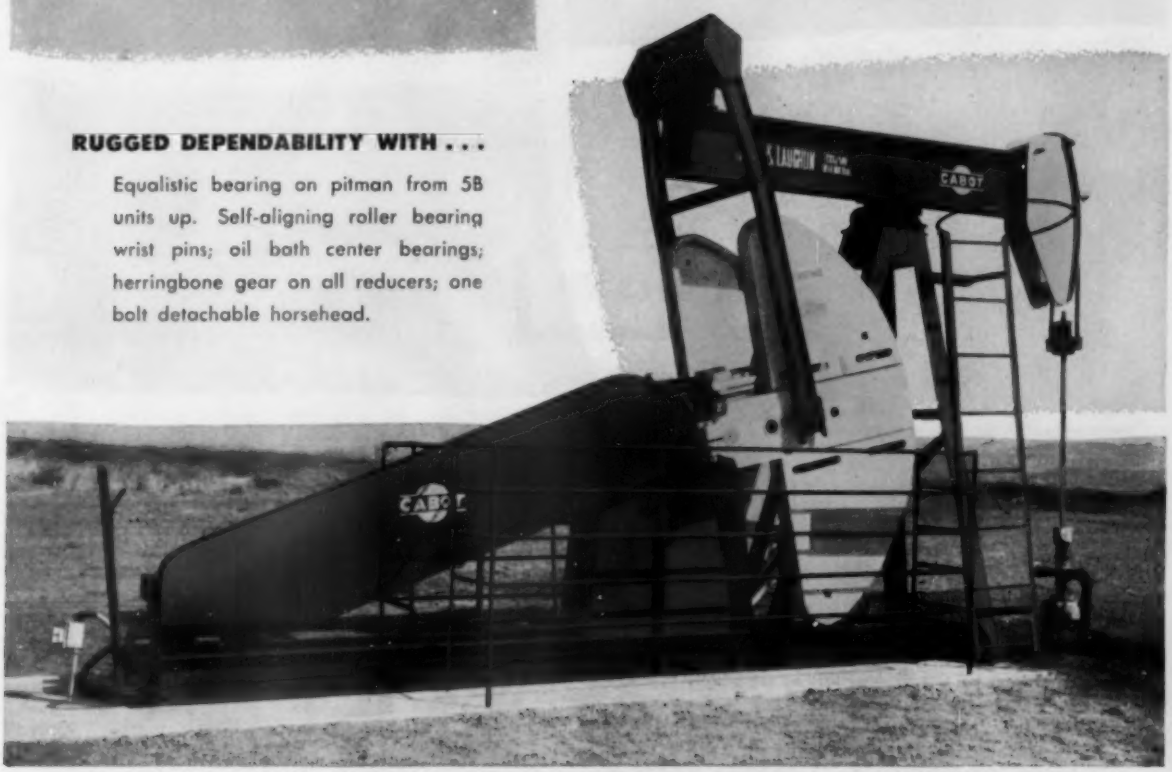

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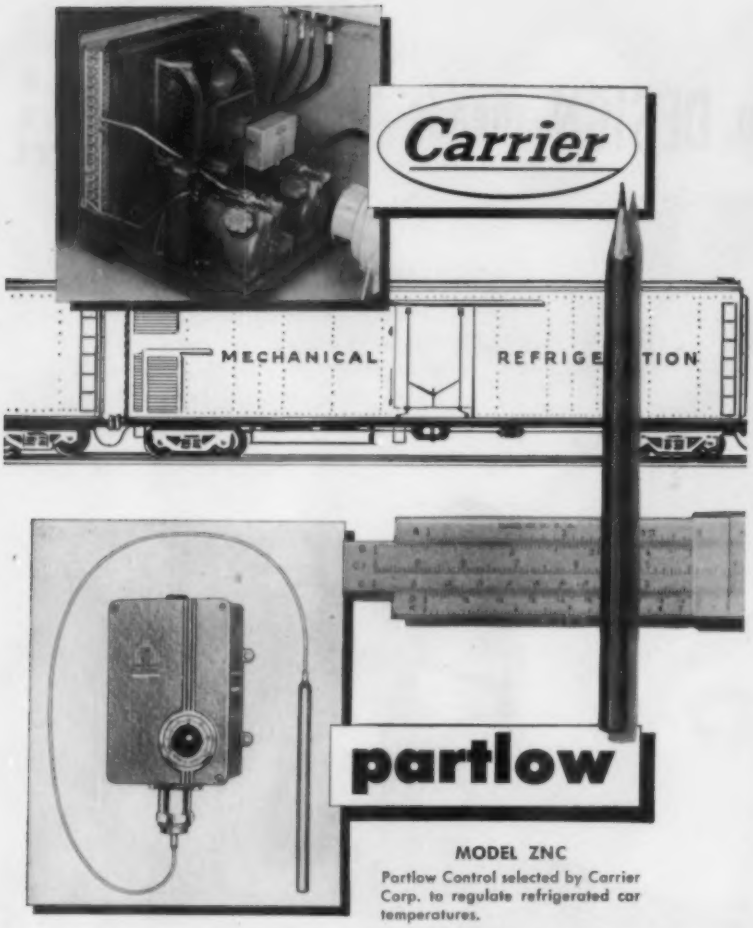

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6	Pennsylvania Grade Crude Oil Association, thirty-fourth annual meeting, Penn-Sheraton Hotel, Pittsburgh.
9-13	American Society of Mechanical Engineers, semiannual meeting, Sheraton-Palace Hotel, San Francisco.
10-12	Interstate Oil Compact Commission, midyear meeting, Yellowstone National Park.
10-14	Gordon Research Conferences, petroleum, Colby Junior College, New London, N. H.
12-14	Engineering Institute of Canada, annual meeting, Banff, Alta.
16-21	American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
17-21	Gordon Research Conferences, catalysis, Colby Junior College, New London, N. H.
18-19	Rocky Mountain Oil and Gas Association, annual meeting of refining committee, Northern Hotel, Billings, Mont.
19-21	Association for Computing Machinery, twelfth annual meeting, University of Houston, Houston.
20-21	Western Petroleum Refiners Association, Mid-Continent regional technical-industrial relations meeting, Broadview Hotel, Wichita.
20-22	National Oil Scouts and Landmen's Association, annual meeting, Hotel Cosmopolitan, Denver.
23-27	Canadian Gas Association, Jasper Park Lodge, Jasper, Alta.

JULY

8-19	Industrial Statistics for the Process Industries, second annual conference, sponsored by American Society for Quality Control and the University of Oklahoma, Lockett Hotel, Norman, Okla.

AUGUST

26-28	Seventeenth annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.
28-30	Instrument Society of America, International Symposium on gas chromatography, Kellogg Center, Michigan State University, East Lansing, Mich.

SEPTEMBER

3-5	Pacific Coast Gas Association convention, Fairmont and Mark Hopkins Hotels, San Francisco.
5-7	New Mexico Geological Society, eighth annual field conference, southwestern Colorado.
8-13	American Chemical Society, 132nd national meeting, New York City.
9-10	Independent Natural Gas Association of America, annual meeting, Shamrock Hilton Hotel, Houston.
11-13	National Petroleum Association, fifty-fifth annual meeting, Traymore Hotel, Atlantic City, N. J.
19-21	Rocky Mountain Oil Show, fairgrounds, Casper, Wyo.
23-25	American Society of Mechanical Engineers, petroleum mechanical engineering conference, Mayo Hotel, Tulsa.
26-27	Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.
26-27	Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, Roosevelt Hotel, New Orleans.
30-Oct. 2	American Oil Chemists' Society, 1957 fall meeting, Netherland Plaza Hotel, Cincinnati.

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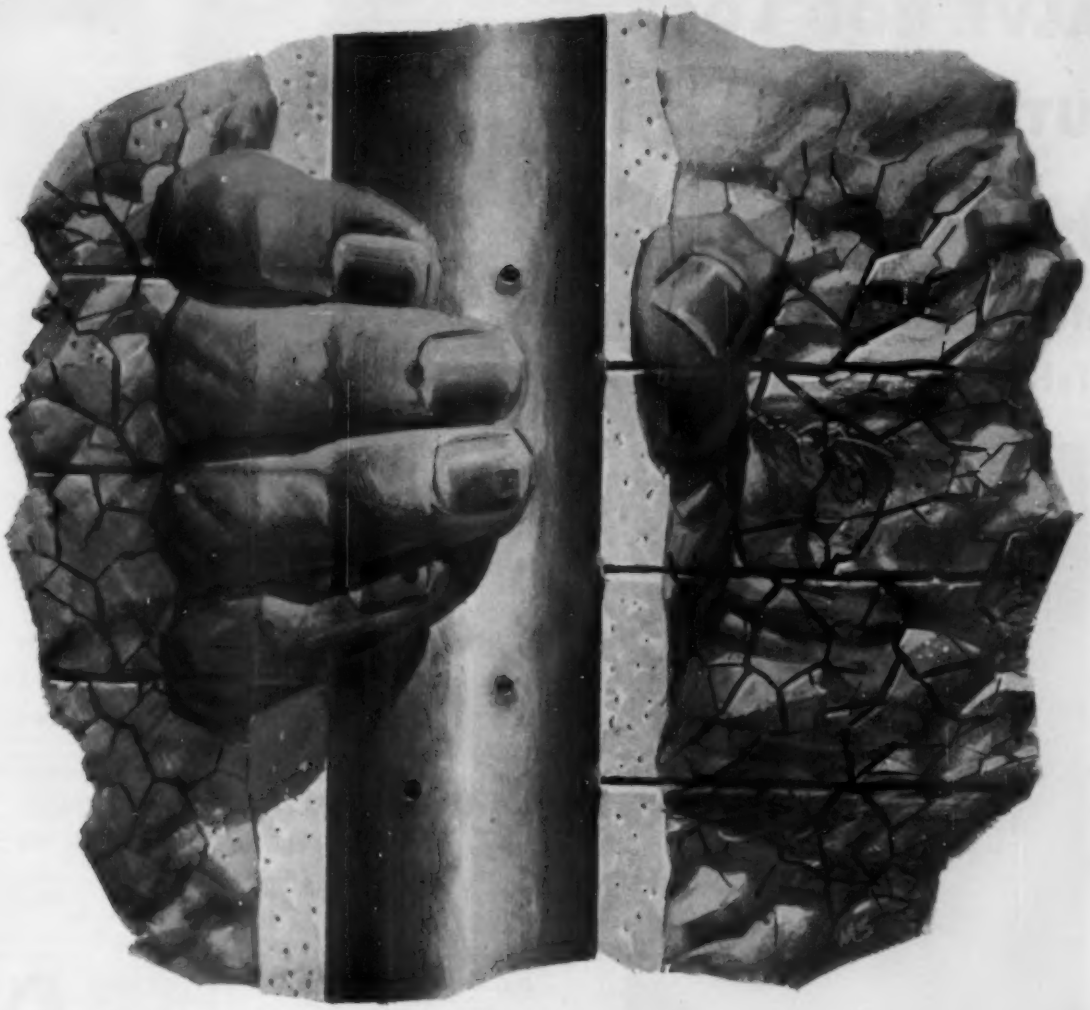

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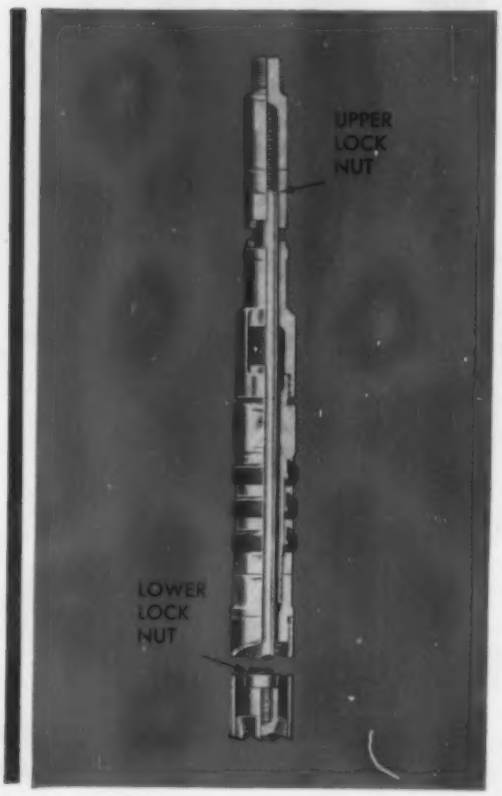

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JOURNALLY SPEAKING

Talking to Ourselves

ASK any oil man what's wrong with the industry's public relations, and he'll reply immediately:

"We just talk to ourselves. We don't tell our story to the public. We just get in private huddles and chew the same old things over and over. We don't talk to the right people."

Since all oil men say this, we figured there must be something to it, and recently we ran across an incident that seems to support it.

Not long ago a big meeting of oil men devoted a half-day session to discussing the industry's public relations. They heard a couple of formal speeches on the general theme that we've got to quit talking to ourselves, got to quit being so secretive, got to take the mystery out of the oil business so people will understand what it is all about.

Then the group had an open forum on the subject and all agreed that, yup, by golly, that's right. We've got to stop being so aloof, got to take the public into our confidence. It was unanimously decided that as soon as they got back home they would all start making friends with their local newspaper editors, would make speeches to civic clubs explaining the oil industry, would pass out literature defending the depletion provision, etc., etc.

It was very inspiring. Almost like seeing the converts hit the sawdust trail at a camp meeting.

There were about a dozen oil writers at this convention, and they kept nudging each other and winking, and wondering how long these good resolutions would last. It didn't take long for them to find out.

That afternoon the meeting was devoted to planning the group's program for the coming year—attitude toward pending legislation, what to do about various current problems, and the like. And the very first piece of business was adoption of a motion to keep the meeting secret and exclude the oil writers.

The oil writers retired to the press room of the hotel to hold an indignation meeting over a bottle of whisky that the public-information officer had generously provided them.

There they made a delightful discovery. The loudspeakers in the press room were still connected to the microphones in the hotel's big meeting room, and every word that was being said in the "secret" session was coming in fine.

You can guess what happened. The reporters locked the pressroom door, and over swigs of the association's whisky they gleefully took down everything being said while the oil men thought they were talking to themselves. Then they used the association's typewriters to write it up for their papers. They hadn't had so much fun in years.

There was just one thing wrong with all this. Behind those closed doors nobody said much of anything that was worth writing about anyway. If the reporters had been admitted they would have been bored stiff and probably wouldn't have written a line.

As it was, the oil writers all went home chuckling over having pulled a fast one and hoping that this would teach oil men a lesson about talking to themselves.

They also reached another conclusion: Not only should oil men stop just talking to themselves; they should also start saying something worth printing.

What's In a Name?

AND speaking of public relations, we see that Sun Oil Co. is trying to make the oil industry more respectable and dignified by dropping the word "gasoline." From now on its pumps will dispense nothing but "motor fuel."

This is in line with the trend away from the rough-and-tumble talk of the industry's salad days. Instead of gas stations we have "service centers" manned by "attendants," and equipped with "rest rooms."

The idea, we presume, is to make the oil industry seem more gentlemanly and refined. The movement shouldn't stop here. If the public is going to be convinced that oil men are nice people, some euphemistic synonyms will have to be thought up to replace all the bad names commonly applied to them by unfriendly congressmen, cartoonists, and columnists.

—*Henry D. Ralph.*

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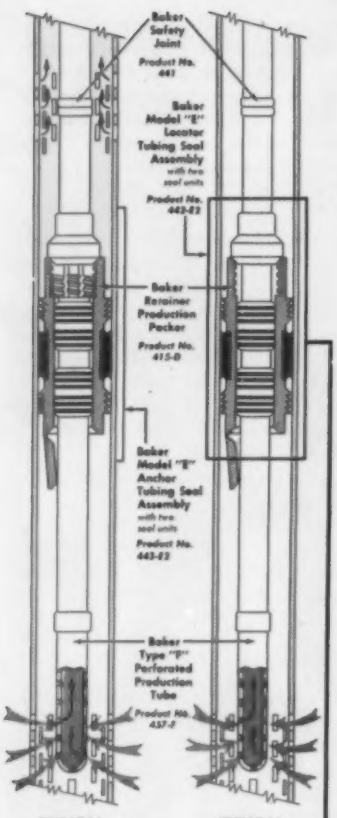
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One way or another, imports will be curbed

SOMETHING is going to be done to limit imports of crude oil into the United States. That much seems certain. Just when, by how much, and by what means are not yet determined.

President Eisenhower says he now agrees that there is reason for the belief that crude oil is being imported in such quantities as to threaten to impair the national security. He has ordered an investigation to determine whether security is in fact threatened.

The President evidently means business. His prompt action is in contrast to the administration's free-trade policy and to his own record of delaying and turning down requests for restrictions or higher tariffs on various other commodities.

THIS IS A BIG VICTORY for domestic producers. Never before have they got even conditional White House endorsement of their contention that imports are excessive. They confidently expect the President to do something about it, and soon.

As to choice of means, the President has broad discretion under the defense amendment to the Reciprocal Trade Act. He has indicated a preference for voluntary agreements with importers. This has been ineffectual in the past, largely because new companies keep entering the import business.

But a voluntary plan is worth one more try. It might work if backed by White House prestige and perhaps Department of Justice sanction for divvying up the imports among all concerned.

A practical voluntary plan would avoid the numerous and really serious problems involved in either a high tariff or a quota system. It would avoid charges of discrimination among companies or among countries, yet could operate to favor higher-cost crude from the Western Hemisphere which is more vital to defense than some other oil.

Furthermore, a voluntary plan would avoid the cumbersome federal regulation implicit in a quota system—regulation which, some fear, would inevitably reach out toward control of domestic production.

JUBILANT PRODUCERS, having gained their point, are patiently awaiting the President's next move. Publicly they express satisfaction with the situation and confidence that some lid will be placed on imports.

But privately they have their fingers crossed. They doubt that the defense amendment is specific enough to curb imports permanently.

If events of the next few months don't suit them, producers are prepared to make an all-out drive for specific limitations on oil imports when the Reciprocal Trade Act comes up for renewal next year. Any fear that federal control would be extended to them is subordinated by the greater fear that unlimited imports will ruin them. And there is strong probability of such legislation if imports are still increasing next year.

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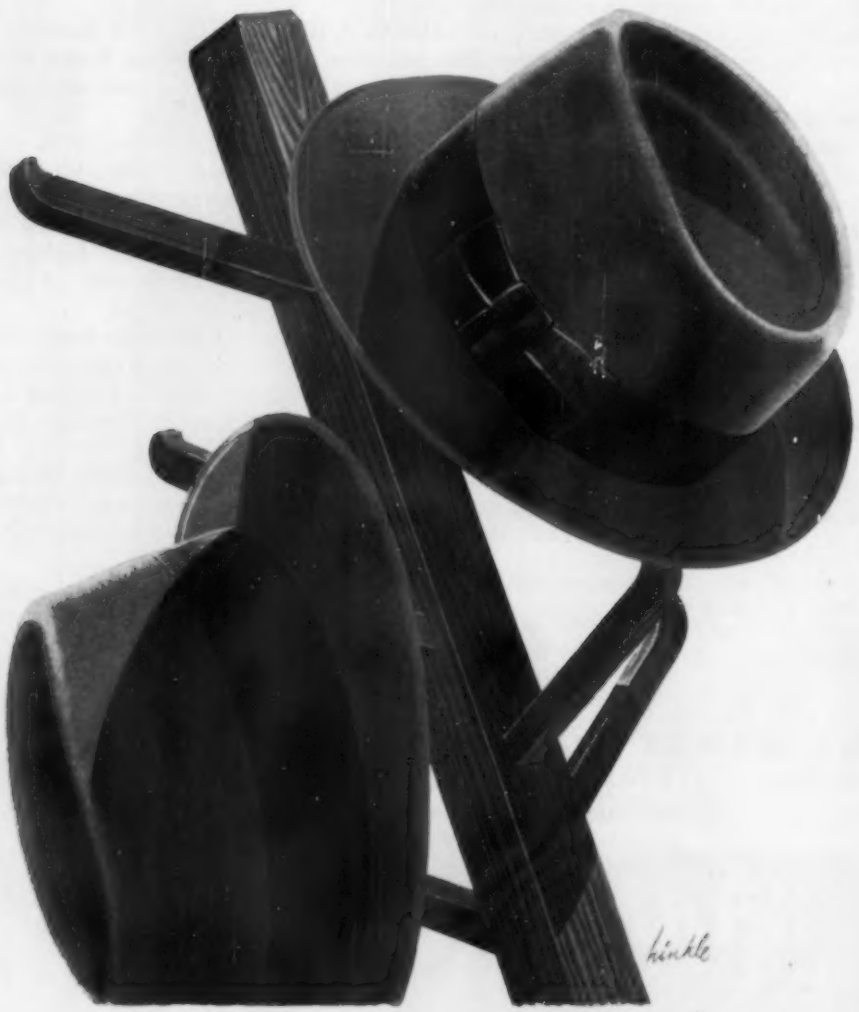
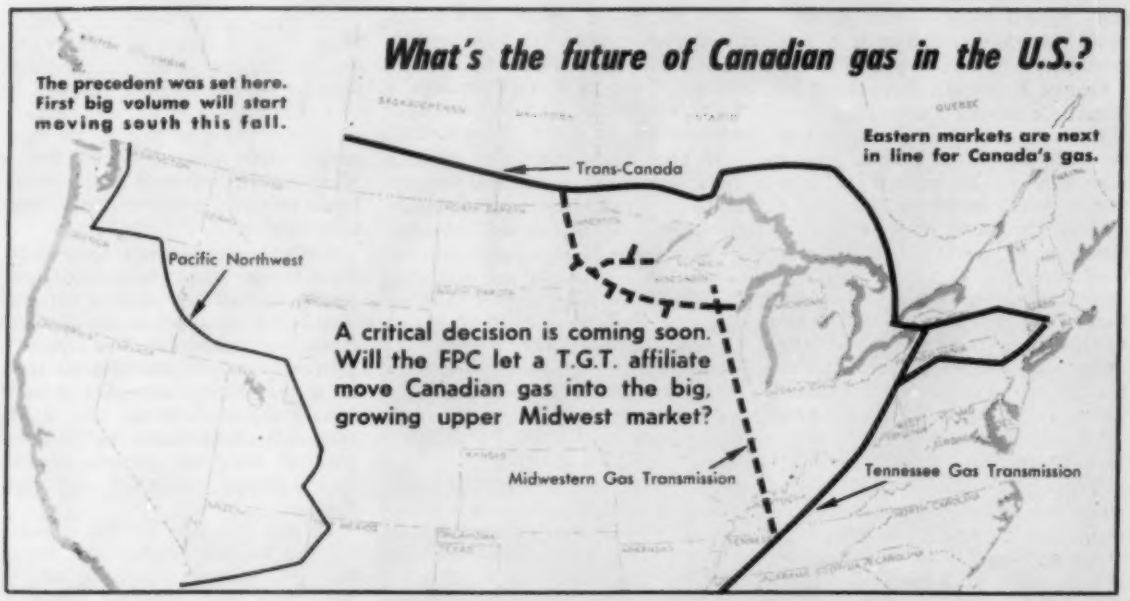


the OIL AND GAS JOURNAL

May 13, 1957


What's the future of Canadian gas in the U.S.?
The precedent was set here. First big volume will start moving south this fall.
Eastern markets are next in line for Canada's gas.
Trans-Canada
Pacific Northwest
A critical decision is coming soon. Will the FPC let a T.G.T. affiliate move Canadian gas into the big, growing upper Midwest market?
Midwestern Gas Transmission
Tennessee Gas Transmission

Pipeline Giants Ready for Big Battle

Joe Reilly

A BATTLE for long-neglected gas markets in the Midwest will resume before the Federal Power Commission May 14.

Four major pipeline groups, three of which are aligned against the fourth, are competing for a share in the big market stretching from the Chicago area north to Canada. Half a dozen other pipelines are involved indirectly through their affiliation with the main contestants. The FPC has on file at least 20 applications relating directly or indirectly to natural-gas service in midwestern states.

The FPC's decision will have more than routine significance. One of the major questions to be answered is whether the new market is to be served exclusively by domestic gas or whether Canadian gas shall get a share of it.

Major contestants are:

... **Tennessee Gas Transmission** Co. and its associated firm, Midwestern Gas Transmission Co.

... **Northern Natural** Gas Co.

... **Peoples Gas, Light & Coke** Co. and its subsidiaries, of Chicago.

... **Michigan Wisconsin** Pipe Line Co., Detroit, a subsidiary of American Natural Gas Co.

The Northern Natural, Peoples, and Michigan Wisconsin group, already serving portions of the Midwest, have joined forces informally in an effort to block Midwestern and Tennessee Gas out of the area. One of their chief objections is that Midwestern would get half of its initial gas supply from Canada.

Besieged by applications from all sides, the FPC called this week's consolidated hearing to consider "mutually exclusive" aspects of competing proposals.

Sudden growth of interest in midwestern markets was sparked by the proposal to import Canadian gas to serve part of the area. Almost immediately, pipeline companies started filing to the FPC with plans to rush domestic gas to neglected markets.

Tennessee Gas Transmission, mastermind of the import plan, is one of the largest and most aggressive companies in the business. Actually, the company has a two-pronged plan calling for imports of Canadian gas into the eastern United States as well as the Midwest.

If the FPC approves the entire import proposal, the Midwest, the West Coast, and even the East Coast will have access to practically untouched supplies of natural gas in Canada's western provinces.

Canadian gas for the West Coast has been assured by a prior FPC ruling. It will go through Pacific Northwest Pipeline Corp.'s new line to Washington and may eventually reach California through the El Paso Natural Gas Co. system.

Now before the FPC is Midwestern Gas Transmission Co.'s request for a permit to move Canadian gas into North Central states. Tennessee Gas, in another application, is seeking Canadian gas as an additional supply for its Eastern market.

Midwestern Gas, infant affiliate of the giant T.G.T., took on a man-sized job in its fight to "invade" the gas-hungry upper Midwest. This is po-

tentially one of the greatest gas markets in the entire country. Opponents have what they consider prior claim to most of the markets being sought by the Tennessee Gas offspring.

Governor Stratton of Illinois recently gave his support to the Midwestern plan, contending that an additional source of gas for the Chicago area "should be encouraged." He estimated that 500,000 more homes probably would use gas for heating if it were available.

George R. Perrine, chairman of the Illinois Commerce Commission, took a similar stand: "I am informed by my staff that if the Peoples application were to be granted at once, that it would hardly be sufficient to take up the present existing applications for gas heating of single-family residences."

Midwestern's proposed system, like Pacific Northwest's new line, would be fed from both ends. The Midwestern line would branch off from the T.G.T. system near Portland, Tenn. From there, it would stretch 1,100 miles northwest to the Canadian border near Emerson, Man.

Telescoping down as gas is sold along the route from each end, the main line would be 24 in. in diameter at the ends and 16 in. in the middle. Branch lines of 8 and 10-in. pipe would serve various markets in Wisconsin and in the Menominee, Mich., area. The company also would serve parts of North Dakota, Minnesota, Illinois, and Indiana.

At first, Midwestern plans to get one-half of its gas from Canada. This would be delivered at the border through a branch line to be built by Trans-Canada Pipe Lines, Ltd.

Possibly later, as is proposed in the Pacific Northwest case, Canadian gas will infiltrate farther and farther into U. S. markets. Through purchase of about 17 per cent of Trans-Canada's stock a year ago, Tennessee Gas acquired a big stake in the Canadian line. T.G.T.'s ownership of the Canadian company was reduced to about 6 per cent by Trans-Canada's sale of additional common stock this spring.

Trade with Canada . . . The elaborate T.G.T. plan calls for a two-way flow of gas across the Canadian border.

Tennessee would export up to 48,000 M.c.f. of gas per day at Niagara Falls, N. Y. This gas would help build up a market in and around Montreal pending completion of Trans-Canada. The U. S. supply then would be replaced by gas from western Canada.

Farther in the future Tennessee Gas and Trans-Canada might trade out at the Niagara hookup to mutual advantage of customers on both sides of the border. Trans-Canada has an option to buy peak-shaving gas as needed from the American firm. In return, T.G.T. can purchase surplus gas from Canada to meet future demands. This transfer, in unspecified volumes, would be made at Niagara or at Rouses Point, N. Y.

As gas demand grows in T.G.T.'s main market area in the eastern United States, the flow of Canadian gas into New York could become a major addition to U. S. supplies now available in the northeastern states.

If the Midwestern line is built there well could be eventual imports of gas in large volumes into the highly competitive markets around Chicago.

Midwestern plans to import up to 204,000 M.c.f. of gas per day from Trans-Canada. An equal volume would come from T.G.T.'s domestic sources. Delivery of Canadian gas would be at the border south of Winnipeg near Emerson. The contract also provides for purchase by Midwestern of an extra 200,000 M.c.f. per day if and when available from Canada.

Export of Canadian gas near Emerson is not dependent on the proposed exchange near the eastern end of the Trans-Canada line.

As officials of the three companies see it, the double trade would benefit both the U. S. and Canada. Trans-Canada would provide a new supply of gas for hungry markets in the Midwest. It also would assure gas for future growth of big markets in the New York City metropolitan area and in New England.

Canada, on the other hand, would profit by obtaining vast markets for gas reserves which have been shut in for lack of an outlet. Also, it would obtain a temporary supply of gas to serve eastern Canada.

Many of our neighbors to the north, to paraphrase a U. S. slogan, feel that "What's good for Trans-Canada is good for all Canada." The future of eastern Canada as an industrial empire will be greatly strengthened by the success of Trans-Canada.

Too, Trans-Canada would lose by far its biggest single initial market should the imports to the U. S. fall through. That would mean a delay in getting the pipeline operations into the black.

Battle in Midwest . . . Most of the controversy in the combined import-export plan centers in the Chicago area and farther north in Minnesota and Wisconsin.

Peoples Gas, Light & Coke, together with its numerous affiliates, is firmly entrenched in the Chicago region. This group has been fighting for months to head off an "invasion" of its markets *(The Oil and Gas Journal, February 20, 1956, page 92).*

Subsidiaries in this corporate network include Natural Gas Pipeline Co. of America, Texas-Illinois Natural Gas Pipeline Co., and Chicago District Pipeline Co.

On the day Midwestern hearings began in 1956 before an FPC examiner, the Peoples group filed applications to increase delivery capacity to the Chicago area by 435 million cubic feet per day. Part of the new supply would come from the Rocky Mountain area through the Colorado Interstate Gas Co. system and Natural Gas Pipeline.

Midwestern's proposed route skirts the Chicago area, where large residential markets are pleading for gas. The board chairman of the Peoples group has estimated that 200,000 persons have been awaiting gas service in the Chicago area *(The Oil and Gas Journal, February 20, 1956, page 92).* Midwestern's pending application does not propose supplies for Chicago residential deliveries, however.

In fact, the sole conflict between Midwestern and Peoples now before the FPC is their competing bids to serve two large industrial concerns. Natural Gas and Midwestern both propose to supply gas to steel plants in the Chicago and Gary regions operated by United States Steel Corp. and Inland Steel Co.

Northern Natural particularly resents Midwestern's bid to enter its territory. Not only does Midwestern want to serve the same markets claimed by Northern Natural, but also would do it with the same gas that Northern Natural planned to use as a supply. And Northern Natural filed applications to serve these markets long before Midwestern entered the picture.

As early as 1954, a year ahead of Midwestern, Northern Natural sought to import gas at Emerson and based its application on a contract with Trans-Canada. Trans-Canada says its agreement with Northern Natural has expired, but Northern Natural claims it is still a live issue.

Michigan Wisconsin and an affiliated company, American Louisiana Pipe Line Co., have been battling Midwestern for the right to serve 11 distributors. The FPC earlier sanctioned allocation of 61,385,000 cu. ft. of gas per day from American Louisiana's system for potential delivery to Michigan Wisconsin in competitive areas.

New FPC policy? . . . Seldom has the FPC had to solve a thornier problem than the one it now faces. The case is especially complex because it involves our "good-neighbor policy" with Canada.

A ruling, whichever way it goes, will be a blow to many producers and pipeliners either north or south of the border.

The FPC already has more than 6,000 pages of transcript to study in the current case. The volume of testimony likely will grow much larger before the new hearings are adjourned.

An examiner's ruling, which often foreshadows FPC policy, indicates a possible new emphasis on aggressiveness in serving natural-gas markets.

Examiner Francis L. Hall stated that opponents "do not and cannot deny the existence of unsatisfied demands for natural gas in the Midwest in excess of Midwestern's proposed initial system capacity of 400,000 M.c.f. per day, nor is there any suggestion that the demands for gas in that area will not grow substantially in years to come."

He added that "for reasons not yet explained in the record" some of the opposing pipelines "have refused to purchase gas at wholesale from Midwestern, preferring instead to attempt to obtain their additional requirements from other sources."

"It is because of this refusal and the known natural-gas deficiency in the area," the ruling continued, "that the chief executive officer of Midwestern and Tennessee testified that he feels free not only to solicit customers of existing pipelines but also others in need of natural-gas service."

The FPC has eased its earlier policy against making a U. S. market dependent entirely on foreign gas. Contrary to its stand in the Pacific Northwest case, the FPC said it might "envisage circumstances under which a project relying wholly upon Canadian gas could be found to be in the public interest . . ." *(The Oil and Gas Journal, November 26, 1956, page 61).*

Actually, victory for Midwestern would give it only a small foot in the door of the upper Mississippi Valley market. Even that, however, is more than the entrenched companies are willing to concede to a pipeline with T.G.T.'s record of market development. They regard this as only a start. It does not take too much imagination for them to see what might happen once the T.G.T. camel got its nose under their tent.

H. E. LINDEN, president of Oil Shale Corp., pins hope on Sweden's Aspeco process as . . .

Oil Flows at New Shale Retort

DENVER.—Oil is being produced from the nation's first shale-oil pilot plant using the new Swedish Aspeco flameless extracting process.

The 24-ton plant was built by the Denver Research Institute of the University of Denver under a $250,000 contract with Oil Shale Corp., Beverly Hills, Calif. Stearns-Roger Manufacturing Co. was contractor.

The institute is trying to improve the process developed by Swedish Scientist Olof Aspegren. Here's how it works:

Crushed shale is heated when it comes in contact with small aluminum oxide ceramic balls, which are preheated to 1,200° F. The shale is fed through one end of a rotating drum and the balls through the opposite end. During this counterflow, the heat from the balls is transferred to the shale, and the oil passes off as vapor. While the balls are being reheated for another trip through the mill, the vapors are cooled and sent through pipes to a separating chamber. The gas and coke residue provide heat for the balls.

Dr. Charles H. Prien, head of the Denver Research Institute's chemical division, said the gas byproduct is of good enough quality to be channeled right into gas pipelines.

Oil Shale Corp. owns 1,300 acres of shale land near De Beque in western Colorado. It contains an estimated 100 million barrels of oil. The U. S. Bureau of Mines estimates that Colorado's shale-oil reserves hold about 900 billion barrels of oil.

The Denver plant is one of two privately financed projects in Colorado. At Grand Valley, Union Oil Co. plans to place its retort in full operation May 18.

1. Rally at Lamesa preceded union drive to Permian basin field where . . .

Union Puts Squeeze on Drilling Crews

LAMESA, Tex.—Union labor apparently has picked the Permian basin of West Texas as a testing ground in its long-awaited drive to organize drilling crews.

Drilling contractors—both large and small—have heard rumblings that union organizers were roaming the oil fields for several years. But last week the first trouble flared.

Pickets suddenly appeared at four rigs of three drilling contractors in a small area in Borden County. The larger contractors with operations spread over other areas or oil companies operating drilling rigs were not affected.

Appearance of the pickets was accompanied by strong statements by officials of the young rig-crewman's union. These labor leaders claimed they already have strength to shut down essentially all drilling rigs operating in the basin. They threatened to do so if necessary to force contractors to meet union demands.

Contractors followed developments closely. They admitted any violence posed a serious threat to their equipment and to them financially, but doubted the union has the strength now to shut down drilling in such a big area.

They assessed union strategy like this: Threaten the local contractors first for chances of a quick victory in a few cases. Then approach the larger contractors and companies. But officials of the larger contracting firms, oil companies, and even of some smaller outfits, claim they haven't even been approached yet by union organizers to talk over the problem.

What happened . . . The union involved is Local 672 of the International Union of Operating Engineers. It staged its picketing show early last week.

Here's how the trouble developed: A large motorized convoy of 150 union members held a rendezvous in Lamesa. Then the group converged on four rigs working within a 2-mile radius in the Vealmoor producing area in southern Borden County.

Some crew members of each rig walked off the floor to join the demonstrators. At least two of the four rigs were shut down for a few hours. There was no violence reported. But contractors claimed some of their hands were intimidated into leaving when demonstrators surged onto the rig floors voicing threats.

Demonstrating lasted about 2 hours. Texas Rangers then arrived to move the union men off the leases. Unionists quickly set up picket lines at entrances to the leases. And 16 union members still were manning a 24-hour picket late last week.

Contractor tool pushers were escorting rig crews across the line under the eyes of a quickly assembled force of Texas Rangers and members of the Borden County sheriff's office.

Despite the lack of violence, oil men reported the situation was a tinder box and could easily blow up.

Owners of the four affected rigs are Cactus Drilling Corp. of Texas, Henry Black Drilling Co., Inc., and Denver Drilling Co., all of Midland. Though fearful for the safety of their nonunion crewmen, companies were in no mood to knuckle under to union threats.

Frank Garrett, vice president and drilling superintendent of Cactus, said the demonstrators "drove in bumper-to-bumper, circled the rigs, crowded onto the rig floors, and mouthed threats and curses. Neither of the two rigs shut down. And all my men but five stayed hitched. I believe the five left because of fear not because of sympathy with the union."

The union demands . . . The peculiar half-strike appears to be directed by union chapter officials in Lamesa and masterminded by higher-ups in Odessa.

Chapter head at Lamesa is E. V. Swygart. Union spokesman at Odessa is O. W. Clark, organizer.

Clark last week confirmed the rig visits in Borden County but denied any threats were made.

"But," he added, "we didn't go to those wells just for fun. We've got enough people signed up to do anything we want to do. If we decided to stop the whole Permian basin, we could."

2. Union leaders came right on the rig floor. 3. Pickets set up after Rangers clear lease.

At Lamesa, Swygart said it's possible the "strike will spread to every corner of the Permian basin" if contractors fail to meet union demands.

Here's what the union is asking:

... **Shorter work week** with same pay. The union wants to cut weekly working hours from 56 to 48. Crewmen would work 6 days, be off 2 days.

... **Transportation to and from rig** furnished by contractor free of charge to crewmen.

... **Paid vacations.**

... **Larger crew.** Average crew would be hiked to five from the present four.

... **Safer rigs.** Union wants a set of safety standards set up and adhered to whereby old and worn equipment would have to be replaced.

Conditions assailed . . . Swygart told The Journal the union has succeeded in less than 2 years in getting like concessions for essentially all drilling crews in California.

Contractor crews in the Permian basin, he said, have "probably the worst working conditions in the world." They are in sharp contrast with those employed by some oil-producing companies. One such firm furnishes station wagons for its crews to ride to work and pays them $5 a day to do it. The same operator, Swygart claimed, has its crews on a 40-hour week.

"They get paid vacations, too, and still make as much as we do while we work almost 50 per cent longer."

In Odessa, Organizer Clark said the union negotiating committee has been trying to negotiate with contractors with no satisfaction. An official with Cactus Drilling disputed this. He said his firm wasn't contacted by the union. He also has been unable to find any other contractor who has been approached prior to the Borden County incident.

Swygart said the union intends to concentrate on an area bounded roughly by San Angelo on the south, Lubbock on the north, Sweetwater on the east, and taking in southeast New Mexico on the west.

The local now has seven chapters in Odessa, Midland, San Angelo, Monahans, Lamesa, and Seminole, Tex., and Lovington, N. M., he said.

Neither of the union officials would say how many rig crewmen the new union has been able to sign up in its 2-year effort in the basin.

Owners to call bluff . . . Basin contractors are largely writing off union threats to shut down basin drilling as "tripe." They plan to call what they consider a bluff.

Contractors doubt that the union has a substantial membership. Even if it is numerically strong, the contractors say, a big rig-labor surplus in the area would defeat any move to keep rigs shut down. New men could be hired faster than the union could pull them off.

Garrett of Cactus Drilling pointed out that the five men who left his rigs early in the week were replaced by trained men the next day. Another company official said, "We could easily replace 50 men if we lost that many."

Pointing up the labor surplus, he said "Cactus now has 10 former drillers working as roughnecks."

The Cactus spokesman replied that union charges that basin crewmen are illpaid and illtreated are untrue. "We pay top wages. And we have a solid, effective safety program headed by a good man whose sole job is to run it."

Basin contractors generally, he said, are operating on skimpy profit margins. "About half of us would have to fold if forced to meet their demands."

The union view . . . Union spokesmen dispute the argument that added cost of meeting union demands would force any contractor out of business.

Swygart said "We can't buy that. We're certain that oil companies are making enough money to pay contractors more, if they had to, to get their wells drilled."

He admitted that all four Borden County rigs still were operating. He claimed at least one, that owned by Denver Drilling, and probably more would be down again. The Denver rig, he said, was operating with only 6 roughnecks at midweek.

Swygart's statement indicated union members during off duty hours were calling on roughnecks still on the job in an effort to pull more men off the Borden County rigs and tighten the screws.

What's involved . . . Officials of the larger drilling contracting firms point out the small contractor is extremely vulnerable to union threats.

Their explanation: The small operator has all his assets tied up

in maybe one or two rigs and their equipment. Any violence that puts the rig out of commission or damages it severely could put this type operator out of business in one blow. He also could be ruined if violence resulted in losing a hole.

Drilling contractors report oil-field working conditions pose a tough problem. It's a rough life and always has been. Some of the larger contractors have launched benefit programs with vacations, paid insurance, and bonus or profit-sharing arrangements. They usually have raised wages along the industry pattern.

But the long hours involved are tough nuts to crack. In the Mid-Continent region crews work 8-hour shifts on three tours daily, 7 days a week. Overtime is paid for work beyond 40 hours weekly. But many of the crew members are out of work during down time or between rig moves. Many of the workers prefer to work as long as they can during drilling operations to offset the idle periods.

Drilling crews on company-owned rigs fare much better. They usually are crack crews, draw $3.40 an hour compared with $2.65 generally paid by contractors, and share in the company's benefit programs including the 40-hour week. They also are transferred to other work by the company during down times.

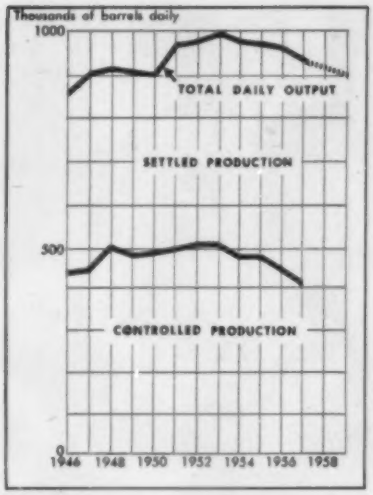
The company drilling crews long have been the envy of other drilling hands. Thus it's natural that the union would use their working conditions as a standard in organizing this segment of the business.

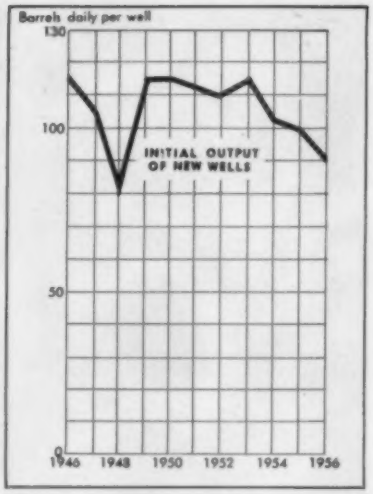
Contractors' side . . . The drilling contractor, however, claims there's a limit to his ability to pay higher wages, shorten hours, or give added benefits.

He acidly points out that the oil companies who pay their own drilling crews better wages aren't willing to increase footage prices so the contractor can do the same. The contractor thus can't increase his labor costs in the face of present footage prices which are inadequate in most localities.

The labor issue also came at a time when the volume of drilling business is down. Over the nation there were 299 fewer rotary rigs active last week that for the same time a year ago. In the West Texas-New Mexico region the total was 20 more idle rigs than a year ago.

Contractors assert the double situation—fewer wells being drilled and low footage prices—puts them in a poor position to increase wages.





Problem in California:

Output Still Slipping

LOS ANGELES. — California's oil production will be down near the 900,000-bbl. mark by the end of the year unless a big field is found soon.

Such a discovery could be made, but it isn't likely.

The state's recent oil-finding record would indicate that any oil found in the next 8 months won't be important enough to check the downward trend in the state's output.

California companies have been looking to offshore development as the means of sustaining their production rate. But there is little hope here. At best, only two or three rigs will be added to the few already engaged in offshore development.

Just recently, in fact, two of the most active groups have announced they will withdraw from their offshore coring programs. The C.U.S.S. group (Continental, Union, Shell, and Superior) will quit June 1. And last week Western Gulf Oil Co. said it is suspending offshore exploration. Both blamed uncertainty of future royalty rates for dropping their programs.

What's happening . . . Projection of the state's production curve for the past 5 years indicates daily output will average about 915,000 bbl. at the year's end.

But in the last 6 months a more rapid rate of decline has set in. Projection of this rate would put December's output at only 900,000 bbl. daily. This would be 30,000 bbl. under April's estimated output.

Here are some reasons the state's production is dropping to its lowest level in the past 10 years:

. . . Lack of discoveries. Last December, for example, only 229,000 bbl. of the state's daily production was from the 296 pools found in the past 11 years. The remaining 713,000 bbl. came from fields found before the end of World War II.

. . . Quality of new producers. Today's new completion has an initial production 25 bbl. lower than the completions of 1953. Five field wells must be drilled now to supply the same volume that four provided then.

. . . High rate of decline. During the past 4 years flush and semiflush fields (those in which maximum efficient rates of production are set by the Conservation Committee of California Oil Producers) have shown an average annual decline of 16 per cent.

When figures are compiled this July for the June 1956-June 1957 period, the rate is expected to be still higher.

Case in point . . . Typical of flush pools with a high decline rate is Santa Fe Springs pool in Santa Fe Springs field.

General Petroleum Corp. discovered this deep pool in February 1956. The discovery was followed by a rash of development wells by the many operators. It was produced at a high rate, and a rapid decline set in.

Production peaked in August 1956 at 5,538 bbl. daily from 23 wells. Last March, the Conservation Committee set an MER of 2,000 bbl. daily as evidence showed a jump in water cut from 1 per cent at the start of the activity to 25 per cent in February.

In addition, gas-oil ratios were soaring. The pool is currently showing a

decline of 11 per cent per month. Fifteen of the 30 wells drilled in the past year are now on the pump due to pressure declines.

This same trend is evident in virtually all the state's flush-pool discoveries of the last year or so. Besides the MER cut at Santa Fe Springs, the Conservation Committee cut Part A in the Oceanic pool of Belgian Anticline field by 1,050 bbl. daily; the Richfield western area of Coles Levee North field by almost 1,000 bbl. daily; the Leda north pool of Guijarral Hills field by 700 bbl. daily in its last recommendation in March.

Since the first of the year the Conservation Committee has cut MER's in a number of California fields by nearly 9,000 bbl. daily. However, this has been offset in some cases by boosts in MERs in a few pools. But the net effect has been substantially to reduce production in California's flush pools.

Royalty Bills Pass

California's lower house votes to raise the cost of doing business offshore, approves three bills to increase rates

SACRAMENTO.—A major step was taken last week to increase the royalty provisions of the Cunningham-Shell Act—and make offshore operations more costly.

The lower house of the California assembly passed and sent to the senate three amendments which would raise the royalty rates.

Only one can be written into law, but any one would increase the payments operators would have to make if they found oil off California's coast. The bills passed by the assembly are:

. . . **Allen Miller's,** which calls for either a mandatory sliding-scale royalty rate with a 16⅔ per cent minimum, with the award going to the highest cash-bonus bidder, or for bidding on a straight royalty basis.

. . . **Joseph Shell's,** which calls for a minimum royalty of 16⅔ per cent with the award going to the highest cash-bonus bidder. Under Shell's amendment, however, the State Lands Commission could, at its discretion, invoke a sliding-scale royalty requirement.

. . . **Bruce Allen's,** which is identical to Miller's.

Each bill would eliminate the present method of classifying lands as either wildcat or proven acreage. Wildcat lands now go for a flat 12½ per cent royalty. Proven lands are awarded on a sliding-scale royalty starting at 16⅔ per cent. The bidder of the highest cash bonus gets the lease in both cases.

Little opposition to the bills developed in the lower house. But much stronger opposition is expected in the senate.

Unexpected support . . . The industry has been almost 100 per cent opposed to changes in the Shell-Cunningham Act. But one oil company executive has said some changes would be acceptable and another caused some eyebrow raising by coming out in favor of amendments.

Several weeks ago, Olen Lane, vice president of Continental Oil Co. and a vice president of Western Oil and Gas Association, said he felt the industry would "hold still" for increasing the royalty rate on wildcat acreage to a flat 16⅔ per cent. But he warned that a sliding-scale royalty for such acreage would wreck California's offshore development program.

Charles S. Jones, president of Richfield Oil Corp., went a big step further. He urged that the law be amended to give the state lands commission authority to ask for sliding-scale royalty bids. He tossed in these two plans for the lawmakers to choose from:

. . . **A specified sliding-scale** royalty plus a variable cash bonus bid.

. . . **A specified cash bonus** plus a variable sliding-scale royalty bid.

Jones said the plans would apply to both proven and unproven lands. "It is obvious," he said, "that the royalty rate of 16⅔ per cent, plus a large cash bonus, eliminates all but the largest producers, and we do not believe this is either to the interest of the industry or the state."

He urged the amendments "in the interests of all of the people."

Against changes . . . The Western Oil and Gas Association has come out strongly in favor of leaving the Cunningham-Shell Act as it stands.

Shell Oil Co.'s Robert T. Patton, chairman of W.O.G.A.'s Public Lands Committee, asked that the original tidelands law be given a "fair trial." Speaking for the association, he said the proposed changes would "represent a reversal of the legislative policy of encouraging exploratory drilling on state lands."

Octanes Pushed Up

Tidewater and Indiana offer higher premiums

NEW YORK.—Two more major oil companies will introduce higher-octane premium gasolines later this month. Both, however, are sticking with the dual-grade system of marketing gasoline.

Standard Oil Co. (Ind.) will start marketing its new Gold Crown Super Premium in the Midwest by May 15. The new grade replaces Indiana's former White Crown premium. At the same time, the company will make available a new higher-octane Red Crown regular. It will have an octane rating equal to the company's premium of 4 years ago.

Tidewater Oil Co. timed introduction of its Super Extra Flying A gasoline to coincide with dedication of the new 130,000-bbl. per day Delaware refinery. This stepped-up premium will be marketed along the eastern seaboard by Memorial Day.

Neither company revealed research-octane ratings of their new premiums. This is in line with general policy, since ratings over wide marketing areas may vary with altitude and other factors. However, the average beefed-up premium in the U. S. now appears to be in the 99-R.O.N. class. Some brands rate in the upper 98-octane range.

Brown Drilling Is Sold

LOS ANGELES.—Belgian and French interests have purchased Brown Drilling Co. and associated companies of Long Beach, Calif.

Purchasers are Societe Financiere de Transports et D'enterprises Industrielles (Sofina) of Brussels and interests represented by Lazard Freres & Cie, Paris. Besides Brown Drilling Co., firms involved in the sale included International Brown Drilling Corp. and Brown Marine Drilling Co.

Present management, at the request of the new owners, will continue to operate the organizations. E. C. Brown is chairman and chief executive officer of the drilling companies. He was president of A.A.O.D.C. in 1947.

Brown Drilling has seven rigs operating in California. Brown Marine has one rig drilling from Monterey Oil Co.'s offshore island at Seal Beach. The international company currently is operating three rigs in Venezuela and one in Turkey. Another is en route to the Middle East.

GAS BILL HUDDLE by Harris, O'Hara, Kuykendall, and Kendall.

Can Gas Bill Survive Ike's Support?

WASHINGTON.—The Eisenhower administration again has confounded supporters of the Harris-O'Hara gas bill.

Administration officials came out strongly in favor of the bill last week. But they hinged support of the measure on two changes that are alarming both gas producers and their friends in Congress. The administration asked Congress to:

. . . **Delete the ban on use of cost** by the Federal Power Commission as a factor in reaching reasonable market price.

. . . **Give the FPC power to review price increases** which do more than reflect tax changes.

Other changes . . . Administration spokesmen indicated that with these changes the bill would be entirely acceptable.

But they also pointed out two other areas where the bill failed to include recommendations of the President's committee on energy supplies and resources policy. These involved:

. . . **Dump gas.** The committee asked a ban on direct sales by interstate pipelines at prices below actual cost plus a fair share of fixed charges. These sales were termed unfair competition with other fuels.

. . . **Underground storage.** The request here is to give interstate pipelines power of eminent domain for developing underground storage. This would allow pipelines to maintain economic load factors throughout the year.

A new bill now . . . The administration's demands immediately raised a question whether the producers would continue to back the bill.

Typical of industry reaction was the comment of Russell B. Brown, general counsel of the Independent Petroleum Association of America.

"We supported the bill as introduced," Brown told The Oil and Gas Journal. "The two amendments offered by the administration, in our judgment, will not accomplish the objectives that the bill would reach. It's a different bill now."

A formal statement was signed by Brown, Charlton Lyons, president of the Mid-Continent Oil and Gas Association; William H. Curry, president of the Rocky Mountain Oil and Gas Association; and S. F. Bowlby, president of the Western Oil and Gas Association. It declared the changes are "totally unacceptable to the vast majority of natural-gas producers.

"If adopted, they would so alter the legislation as to make it a guarantee that the intolerable burdens, confusion, and uncertainty which now plague the FPC and the industry would continue. They are contradictory to the principles behind the Harris-O'Hara bill, and their enactment would make the legislation largely meaningless," the statement said.

Bill's future dim . . . Sharp words of criticism also came from the Texas Independent Producers and Royalty Owners Association.

A. E. Herrmann, president, and A. H. Rowan, chairman of TIPRO's gas committee, said the administration's position was "shocking."

"We urgently hope the President will review the testimony," they said. "We are convinced the proposals are foreign to his announced position and his general concept of sound government."

The changes would "practically denude" the bill of provisions favorable to the producers, Herrmann and Rowan said. The association is "unequivocably opposed" to the amendments.

Backers of the bill also predicted that the changes would make it difficult to get the measure through Congress.

The hearings . . . The administration position was revealed soon after hearings on the bill got under way before the House commerce committee. Rep. Oren Harris of Arkansas, author of

the House bill is committee chairman.

Administration's views were expressed in reports from the Office of Defense Mobilization, Federal Power Commission, Budget Bureau, and Interior Department. All held that the measure was desirable, with the changes outlined.

The agency reports were buttressed by oral testimony from Charles H. Kendall, general counsel of ODM, speaking for that agency and the Budget Bureau, and Jerome K. Kuykendall, chairman of the FPC.

The Harris-O'Hara bill "appears" to provide the additional consumer protection demanded by the President last year, Kendall told the committee.

But the administration does not believe that a ban on the study of costs is necessary, Kendall said. The FPC could be allowed to study costs, where it deemed it necessary, without violating the prohibition against putting producers under utility-type regulation.

"While it is expected that more appropriate regulation will result from the abandonment of the public-utility rate-base formula, it is not inconceivable that the FPC may in some cases feel the need of cost data in the process of exercising its judgment and discretion," Kendall explained.

Kendall admitted that he could not, off hand, think of a situation in which this would be necessary. But he insisted that the FPC should not be barred from any avenue of study which it thought would contribute to a proper decision.

Kendall also defended his position that the FPC should be given power to review price increases in definite pricing contracts.

"To the extent that stepup clauses in existing contracts result in prices which exceed the reasonable market price, the commission should continue to have authority to limit the increase to such part thereof as does not result in a price exceeding the reasonable market price," he said.

Threat of veto . . . Kendall indicated strongly that without deletion of the ban on using cost the bill stands a big chance of being vetoed.

But he agreed with suggestions that the provision for review of existing contracts might be modified in view of the terrific possibilities of findings by the FPC that prices in long-standing contracts were unreasonable and should be voided.

Harris, himself, expressed concern over the latter. He urged Kendall to see if a more satisfactory approach can be developed.

The administration's demands brought appeals from Harris and other members of the committee for a statement by the President whether he would sign a bill "generally" in line with his policies.

Rep. Martin Dies of Texas charged Kendall with wanting to make it easier to administer the Phillips decision without making any concessions. "We started out here on the basis that the Phillips decision was wrong," he reminded the witness.

Kendall's suggestions so aroused the committee that it kept him on the stand through the first two of four sessions in which 17 witnesses were to be heard.

Kendall was followed by Kuykendall. He told the committee the bill would protect consumers while giving producers an incentive to find and develop additional gas reserves.

Role of the states . . . The bill also will leave the states free to enforce their conservation measures, Kuykendall pointed out. The only exception is that state or local authorities may not regulate the price of gas either at or before the beginning of its interstate transportation.

The limit on the price powers of the state, however, would not apply to orders in effect on June 7, 1954, the date of the Phillips decision, Kuykendall explained. This clause apparently is intended to validate Kansas and Oklahoma minimum price orders then in force, he said.

The Interior Department's report on the bill did not go into its technical details. But Acting Sec. Felix E. Wormser gave several reasons why the measure should be adopted:

"Heretofore, no other natural-resources industry has been subjected to public-utility type of price control. The need to control the price of gas at the wellhead is different from the necessity for control of transportation of gas in pipelines and control of its distribution in municipalities.

"Under our free-enterprise economy, our natural-gas resources are developed by those who are willing to take a chance on finding gas. Some efforts are successful. Most are not. If successful, the operators are entitled to sell the gas in an open competitive market. There are thousands of producers and competition is keen.

"The Supreme Court decision in the Phillips case in 1954, in the view of many, was not in conformity with the apparent intent of Congress that the production and gathering of natural gas should not be subject to the Natural Gas Act. The bill appears to correct this action of the Supreme Court and at the same time appears to provide protection for consumers against unreasonable prices."

Industry briefs

Gridoil Freehold Leases, Ltd., has made a $3,000,000 deal with Col. Gustave Ring, private investor, for a drilling program in western Canada. Fifty drill sites on Gridoil leases have already been selected, primarily in southeastern Saskatchewan.

Ring will provide the funds against the security of producing reserves. Each well will become the property of the investor, with the exception of 6¼ per cent overriding royalty. Gridoil will retain the balance of surrounding acreage. The company, owned 62 per cent by Anglo American Exploration, Ltd., has more than 520,000 acres of freehold leases in Saskatchewan and Manitoba.

Atlas Exploration Co., Houston, has changed its name to Atlas Laboratories, Inc. The new name more accurately reflects the company's activities. There is no change in personnel or policy. The company will continue to produce and market gravity meters and gas detectors.

Scurry-Rainbow Oil, Ltd., of Calgary will take over Canadian Pipe Lines & Petroleums, Ltd., in a stock-exchange deal approved by stockholders of both companies. Scurry-Rainbow will issue stock to Canpipe stockholders on a share-for-share basis. There are approximately eight million shares of Canpipe outstanding.

Alberta's crude-oil allowable for May has been set at 435,684 bbl. daily. This is about 15,000 bbl. daily below the all-time record of 448,696 set last August. Pembina will again lead the field with 114,638 bbl. daily. Redwater and Leduc-Woodbend will be second and third.

Colorado Interstate Gas Co. has received temporary FPC authorization to build a 50-mile, 22-in. pipeline from Mocane field, in the Oklahoma Panhandle, to its present system at Hooker. Cost of the line will be $2,424,441. It's part of an expansion project to permit Colorado Interstate to deliver 460,000,000 cu. ft. daily to Natural Gas Pipeline Co. of America at Beatrice, Neb. *(The Oil and Gas Journal, October 1, 1956, page 66).*

The complete pipe supply for the Alberta-Winnipeg section of Trans-Canada pipeline has been delivered and the pipe is on the ground. Officials of Trans-Canada Pipe Line Co., Ltd., expect the line to make first deliveries to Winnipeg in September.

Automation Yardstick

Study shows automatic stations can add line horsepower at no extra cost, but longer payout time is big factor

CLEVELAND.—Automatic pipeline booster stations to increase throughput get the nod over manned stations any time a 2¾-year payout is acceptable.

And ideal station spacing will decrease with the use of automatic stations.

These are among the conclusions drawn by N. B. Mavris of Continental Pipe Line Co., Ponca City, Okla., in a paper presented last week at the annual pipeline conference of the A.P.I. Division of Transportation.

Mavris made a detailed study of the effects of automation on the economics of pipeline expansions.

His cost analysis does not offer a ready-made solution for every situation. But it does provide useful general answers to the "loops or booster" and "manned or remote" questions which face pipeliners regularly.

N. B. MAVRIS
. . . A formula for pipeline economics.

Systems studied . . . The unit chosen for study was an initial station and single-line system.

Lines of 8, 10, and 12-in. diameter were analyzed. Equal-diameter loops were used because this is the most economical size for a single-length loop. Original station spacings of 30, 50, 75, and 100 miles were established for initial conditions of the study.

These six basic assumptions also were made:

. . . **Stations were equipped** with electric motors and centrifugal pumps.

. . . **Maximum station pressure** was 1,200 psi.

. . . **Pump-unit capacities** were based on 50 per cent and 100 per cent increase in volume.

. . . **Intermediate stations** were on 24-hour operation.

. . . **Communication system** with channel space was in operation.

. . . **New pipe was used** for loop lines.

Conclusions . . . Mavris' study indicated a manned station was justified only when the 2¾-year payout was unacceptable for the added investment required for automatic operation.

When will the booster be favored over the loop? The dividing line is indicated by this example with an 8-year payout requirement and 50-mile station spacing:

For a 50 per cent capacity increase, the automatic booster would be the best choice. Above 60 per cent, economics favor the loop. Volume increases above 50 per cent require two stations. This tends to favor looping.

Considering again the 8-year payout, 46 miles was shown to be the optimum spacing for manned stations. For the automatic station, the optimum was 43 miles.

This means more stations can be added, thus increasing horsepower on the line, with use of automatic boosters. Cost of adding the stations is offset by lower operating costs through reduced manpower.

In almost all cases where the capacity increase is to be more than 50 per cent, the loop line is favored.

The exception is on systems with longer station spacing—above 70 miles. For increases up to 50 per cent and spacing below 70 miles, the loop is indicated. The booster is generally favored for spacing above 70 miles.

Investment costs . . . The following investment costs were computed for the hypothetical systems studied:

. . . **Loop lines,** $20,000 per mile for 8-in., $23,000 per mile for 10-in., and $33,000 per mile for 12-in.

. . . **Station construction,** on outside units with concrete block switch-gear and supervisory equipment, $20,000 plus $150 for horsepower for 8-in., $23,000 plus $150 per horsepower for 10-in., and $27,000 plus $150 per horsepower for 12-in.

. . . **Supervisory equipment,** $7,500 plus $230 per point and $3,000 for channel, or $12,800 for one-unit stations, $14,640 for two-unit stations, $16,480 for three-unit stations, and $18,320 for four-unit stations.

. . . **Telemetering,** $2,000 per function plus $3,000 per channel or $15,000 per station.

Suntide Selling Out

Southern Natural planning to buy big coastal refinery

CORPUS CHRISTI.—Southern Natural Gas Co. is stepping into refining with the purchase of Suntide Refining Co.'s 65,000-bbl. plant here.

In a $50,000,000 deal announced last week, Southern Natural is rounding out plans to buy Suntide's 3,100,000 shares at $12 per share by January 20, 1958. The company will also assume Suntide's $13,000,000 debt.

Principal stockholder of Suntide is Sunray Mid-Continent Oil Co., Tulsa, which owns 46 per cent.

In addition to the Corpus Christi refinery, Suntide owns 430 miles of pipelines within a 150-mile radius of the refinery. The firm does not market products under Suntide, but sells to other companies, primarily in the East.

F. L. Martin, president of Suntide and one of the principal stockholders, said last week he expected the contract would be signed within a few days. Stockholders still must approve the sale.

The refinery was built in 1954 with a designed capacity of 26,300 bbl. daily. But steady expansion pushed capacity to 65,000 bbl.

Southern Natural, with headquarters in Birmingham, operates more than 3,800 miles of transmission lines in the South and Southeast. It has oil and gas production in Louisiana and Mississippi.

C. L. Chenery, chairman of the board of Southern Natural, said the company plans to form a subsidiary to operate the refinery.

FPC Gets New Authority

WASHINGTON.—The Federal Power Commission has authority to approve an independent producer's gas-sales contract, even though the contract is for a limited period of time.

This is the ruling of the Supreme Court in an appeal brought by Sunray Mid-Continent Oil Co.

Heretofore FPC has refused to approve contracts with an expiration date. Sunray applied for a certificate to fulfill a 10-year contract to supply gas to United Gas Pipe Line Co. The commission denied the certificate, saying this would permit abandonment of service in violation of the Natural Gas Act.

The Tenth Circuit Court reversed the finding. It ruled there is a distinction between abandonment of service by a public utility and the expiration of a specific supply contract after its terms have been fulfilled. The Supreme Court affirmed this finding.

Gas Sales Defined

FPC says it's interstate beyond christmas tree

WASHINGTON.—The Federal Power Commission last week disclosed how gas may be sold without price control.

So long as gas does not move beyond the christmas tree before going into an interstate pipeline it is a sale of gas "in place in the well" and not a sale in interstate commerce, FPC Examiner Emery J. Woodall ruled.

Woodall held that a sale made by Continental Oil Co. to El Paso Natural Gas Co. from a single well in the Langmat field, Lea County, New Mexico, does not come under FPC control.

The only facilities owned by Continental, in addition to the well pipe, are the casinghead, a bleeder valve, and two master valves and their connections. Delivery is made at the point where these facilities end and those of El Paso begin—at the point where the gas enters the 4-in. by 2-in. reducing swage at the top of the christmas tree.

Examiner's reasoning . . . Woodall's decision rejected a claim of the FPC staff that this was an interstate sale. Continental, he said, can't produce the gas because its facilities are incapable of controlling the flow of the well. The gas sold was not gas in motion. The first movement occurred when El Paso put in facilities to allow the flow of gas.

The Natural Gas Act does not require authorization for the drilling of a well or installation of facilities such as Continental has, Woodall ruled. There has never been a court decision or FPC order requiring certification, he said.

The FPC has 30 days in which to suspend the decision. If not held up for review, it will then become final.

Pipeline briefs

. . . from A.P.I.'s Annual Pipeline Conference in Cleveland

A Standard Oil Co. (Ind.) experiment with unattended pipeline deliveries to a bulk plant has turned up some good and bad points of automation.

The project cut down on paperwork, costly backhauls, vapor losses, tankage, and manpower. And it resulted in more freedom for the plant agent and less dependence on weather and road conditions. But it also meant higher investment and maintenance costs and more work for the dispatcher. The report was made by W. D. Lomax and H. W. Wilker of Indiana Standard.

A multimillion-dollar bill is facing the pipeline industry if it has to foot the cost for relocating pipelines crossed by the 42,000-mile national highway program. Earl W. Unruh, president of Sinclair Pipe Line Co., urged a united industry front to prevent this from happening.

Unruh was moderator of a panel session which pointed out that relocation is already a costly headache in states such as Texas where pipeline companies frequently are not reimbursed by counties which have to pay for state highway right-of-way. Pipeline executives noted there are indications that the superhighway costs may be paid out of federal funds. But they also expressed fear that the Government might decide that, since pipelines are paying some of this cost already, they might as well pay all of it.

Right-of-way costs have ballooned from $300 to $500 per mile 30 years ago to almost $5,000 per mile today. Cost may soar to $10,000 to $20,000 soon. One pipeline reportedly paid $40,000 recently for a single 1,000-ft. strip in Texas.

These figures were presented by Fred A. Crane of Sinclair Pipe Line Co. Crane warned that the cost will continue to spiral unless right-of-way men have more time to buy land and more flexibility of location, and there is more rigid contract enforcement.

Positive-displacement meters in the 2,800 and 10,000-bbl. per hour range have filled the bill for line measurement at high rates of flow, according to D. C. McKinley of Interstate Oil Pipe Line Co., Shreveport.

McKinley said future developments, however, point to meters with 4,000 to 10,000-bbl. per hour capacity for pipelines and 40,000 for terminals. The latter would greatly speed supertanker loadings and cut time in port.

National Tube Division of U. S. Steel Corp. showed off the Lorain works, largest integrated steel mill in the world, for some 500 pipeliners. The group spent a full day viewing the plant, from the ore-unloading stage to final inspection of seamless pipe.

But when it came to the climax—actual pipe extrusion—a piercing mill broke down. So the pipeliners observed a repair job instead. But they came away awed by the magnitude, speed, and efficiency of the operations of this company which produces 75 per cent of the seamless pipe in the U. S.—all of it above 14-in.

Also for Pipeliners . . .

Four pipeline giants square off this week before the FPC in an effort to get a big slice of the Upper Midwest gas market. One of the big factors before the commission is: How far should the U. S. go on Canadian gas imports? (P. 75) . . . Eisenhower administration is supporting gas bill but has demanded two amendments which threaten to kill measure (P. 82) . . . Study shows automatic stations can add line horsepower at no extra cost but longer payout time is the big factor (P. 84) . . . FPC now says gas is in interstate commerce at any point beyond the well's christmas tree (P. 85) . . . Pipeliners were told at Cleveland convention that morale of a worker depends on his ability to be productive (P. 86) . . . A new 440-mile, 24-in. products pipeline will be built from Philadelphia to Cleveland by Gulf, Sinclair, and Texaco (P. 90) . . . El Paso Natural, Westcoast are dealing for a commitment on the 32½ per cent interest Husky holds in Savanna Creek field production (P. 91) . . . A big-inch pipeline giving Iran's new Qum field an outlet to the Mediterranean may be the next new line in the Middle East (P. 95).

PLUS THESE TECHNICAL FEATURES: Electronic computers mean speed and accuracy in designing field plants, a case history (P. 132) . . . and Pipeline Patrol's construction report (P. 163).

Labor Lowers Sights

Union policy board abandons 27-cent demand; offers now split between 5 and 6 per cent, with the bulk favoring 5

DENVER.—Labor's unsuccessful demand for a 27-cent hourly wage increase has been revised downward. Now it's more in line with what the oil companies have been offering workers this year.

The Oil, Chemical, and Atomic Workers International Union abruptly changed courses last week, after 5 months of insisting on 27 cents.

The powerful 52-man bargaining-policy committee met at union headquarters here in an emergency "strategy" session to review counterproposals from the oil industry.

Ignoring O.C.A.W.'s big demand, oil companies have swamped labor with offers of 5 per cent, or about 13½ cents an hour. One big company, Gulf Oil Corp., offered O.C.A.W. 6 per cent just about the time the bargaining-policy committee meeting was getting under way. This is O.C.A.W.'s highest offer.

But the O.C.A.W. wouldn't tell how much lower its new demands are. One source said 5 per cent was definitely rejected, but 6 per cent was not rejected.

President O. A. Knight said that "further negotiations with the industry can be more flexible from the standpoint of both employes and union if we do not at this time publish our intentions."

The silent treatment may be a move to gain more time to establish 6 per cent as a national pattern. Sun Oil Co. paved the way for 6 per cent late in April by making the offer to independent unions. This was followed by Gulf's proposal to O.C.A.W.

While he is hopeful for an early settlement, Knight pointed out a "number of bargaining groups are now prepared to strike, if need be, on short notice."

And indeed in some important refining areas, favorable strike votes have been taken. At Port Arthur, Tex., workers in both The Texas Co. and the Gulf Oil Corp. plants have voted for strikes. A threat also hangs over some refineries on the West Coast, including Texaco's Wilmington plant, and General Petroleum Corp.'s refinery at Torrance.

Five per cent bandwagon . . . But it's doubtful that O.C.A.W. would resort to widespread strike action now, since some of its bargaining units have already accepted 5 per cent. These include Pure Oil Co. and Socony Mobil Oil Co. marketing workers in Detroit, International Refineries, Inc., at Wrenshall, Minn., and Aurora Gasoline Co. workers at Detroit.

However, Knight does not regard these agreements as setting a pattern because the marketing settlements are "local" and the refinery agreements involve "independents."

Standard Oil Co. (Ind.) broke the ice in 1957 negotiations in March when it offered the 6,500-member Independent Petroleum Workers of America 4 per cent at its Whiting, Ind., refinery. The union, which is not affiliated with O.C.A.W., accepted.

The same offer was made to another independent group, the 12,000-member Central States Petroleum Union. But Central States wanted at least 6 per cent. Last week, Indiana Standard went up to 5 per cent, and Central States accepted.

Meantime, other companies were making 5 per cent offers. Socony, Pure, Shell Oil Co., Phillips Petroleum Co., Standard Oil Co. (Ohio), and Republic Oil Refining Co. were among the first to jump on the bandwagon.

Since May 1, more companies have come up with 5 per cent wage hikes—in most cases for workers not represented by bargaining units. They include General Petroleum Corp., Sunray Mid-Continent Oil Co., Ohio Oil Co., Standard Oil Co. of California, The California Co., and Pan American Petroleum Corp.

Esso will vote . . . The O.C.A.W. has bargaining units in just about every major oil company in the nation—with the exception of the Standard Oil Co. (N. J.) family.

Recently, however, workers at Esso Standard Oil Co.'s big Bayway refinery at Linden, N. J., voted to ask for O.C.A.W. affiliation. So the National Labor Relations Board will conduct an election at the Bayway plant May 16.

More than 2,000 employes are eligible to vote. Final approval is likely, since 85 per cent of the eligible workers favored affiliation in the April 5 preliminary election.

The April 5 election came a day after Esso laid off 513 craft and processing employes at the 168,000-bbl. plant *(The Oil and Gas Journal, April 15, page 83)*. The layoff occurred when Esso shut down the plant's No. 1 fluid catalytic cracking unit, built during World War II. This unit had about one-third the capacity of Bayway's newer No. 2 unit.

The Esso employes are members of the Independent Petroleum Workers. Affiliation with O.C.A.W. would strengthen their bargaining position. It would also give O.C.A.W. a foothold in Esso refineries. The company operates six refineries in the East and South, with total capacity of more than 650,000 bbl. daily.

How the worker views his job:

Morale Hinges on Productivity

CLEVELAND.—Pipeline executives—and industry at large—were urged last week to take a long hard look at their ultra-efficient job structures, and see if they don't want to do an about-face.

Of the three phases of a "whole job," split up into planning, doing, and evaluating, industry has left the dreariest part for the worker—the doing.

This has been done in the name of division of labor, specialization, and increased efficiency to cut costs and raise productivity.

Taken to extremes, this course may boomerang. The result may not be more production, but less; not lower costs, but higher.

This is the theory of O. A. Ohmann, director of organization planning and management for Standard Oil Co. (Ohio), presented in a paper before the annual A.P.I. pipeline conference.

What's wrong? . . . Ohmann, a former businessman, psychology professor, and personnel consultant suggests a reexamination of the relationship between worker morale and productivity.

His theory is a job is the center of a man's life.

He ridicules the widely accepted philosophy that "we must be nice to people so that they will be happy workers and will in return work harder for their humanitarian employer."

He believes a better case could be made for the reverse—that high morale is a consequence of high productivity, not the cause of it. It's

the productive worker who feels that he is growing in skill and is fully earning his pay by the contribution he makes. He will derive the greatest job satisfaction.

Ohmann says there is some evidence that standardization to control product quality and cut costs has backfired, resulting in reduction of a worker to a mere unit of labor.

He points to 20 per cent higher wages paid by the auto industry in Detroit above the rates for similar work in other industries, and cases of outright sabotage of product quality.

A new program . . . To reclaim the employe's identity from the impersonal stream of production, Ohmann would restructure jobs to put "the whole man back to work on the whole job." He would:

. . . Have managers share some of their prerogatives. It isn't so that the boss always has the best solution to all problems. Let the men share in planning and evaluating as well as the actual doing.

. . . Enlarge jobs that have been too highly specialized. Train a worker to do several jobs in sequence, rotate workers, recombine some jobs.

. . . Encourage ideas from rank and file operating personnel.

. . . Decentralize more, and delegate more decision making.

. . . Extend counseling and performance appraisal, now practiced in management development, to non-supervisory employes.

Cuba Trade Brewing

New firm dickers for big acreage blocks on island

A BIG concession-swapping deal now in the works in Cuba may, if it pans out, be the tonic for a new leasing and exploration surge in that country.

Cuban Land & Royalty Co., headed by Rufus Brent of Dallas, as president, is negotiating for about 3,000,000 acres of leases under concession rights in Cuba.

The company has also acquired roughly 1 per cent overriding royalty "or the equivalent" on about 20,000,000 acres there.

The royalty acreage is held by Trans Cuba Oil Co., Cuban Venezuelan Oil Voting Trust, and White Eagle International Oil Co.

Brent declined last week to identify other officers of the recently organized firm, saying only that they were located in Dallas and New York.

watching WASHINGTON

. . . with Bertram F. Linz

The grand jury squabble . . .

THE Justice Department is seen now as committed to an all-out effort to get indictments out of the grand jury in Alexandria, Va.

A squabble over the way the inquiry was being handled last month led to the resignation of Horace L. Flurry, who originally headed the investigation. The antitrust division tried to keep the quarrel in the family, but Flurry made his side of the story public. And the dirty linen was out on the line for the neighbors to see.

Flurry charged that the investigation was being turned into a fishing expedition. Antitrust chief Victor R. Hansen blasted back that Flurry's ideas would have made the inquiry a failure.

Now the anti-big oil group in Congress is watching every move closely. A department move to prevent companies from destroying their records convinced some members that Flurry was right.

Sometime soon Flurry is expected to tell his story to a congressional committee. Hansen will be given an opportunity to refute his charges.

The Navy and San Nicolas . . .

THE Navy Department isn't asking for any money this year to hunt for oil on San Nicolas Island off the California coast.

But whether the department has given up on looking for oil there is still a question. It is now finishing up the geologic mapping of the island.

Last year the Navy had a request in Congress for $529,000 for test drilling. The outcry of California oil men led to the request being turned down. There is every indication that a further effort to get the money would meet the same fate.

There is still one way the Navy might get its drill into San Nicolas. It might induce the President to set the island aside as a naval petroleum reserve. Then the department could ask Congress for money—with a chance of getting it.

So far this idea is just in the talking stage. It isn't likely to get much further in time to get money from Congress this year even if it is pressed.

Who gets the shale plant? . . .

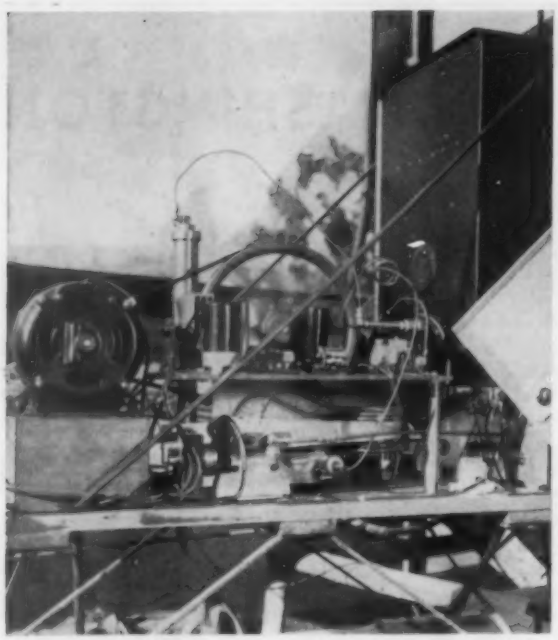
THE next move in research by the Government on oil from shale is up to Congress. And unless Congress does something about it, the experimental plant at Rifle, Colo., will be an orphan come July 1.

The Bureau of Mines dropped its oil-shale research something over a year ago. Last July it transferred the Rifle plant to the Navy. Since then the plant has been kept in standby by the bureau, with the Navy footing the $213,000 bill.

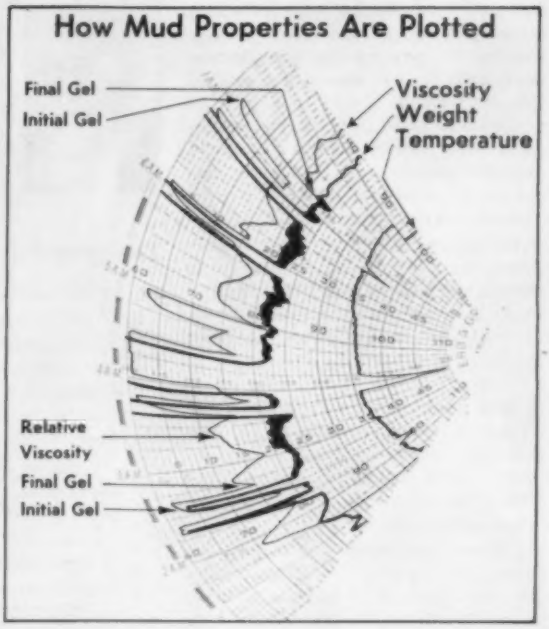
Recently, the Interior Department asked for return of the plant. The Navy said it wanted to use it to see if heavy fuel for ships could be made from shale. But the Navy dropped the maintenance item from its budget for the coming fiscal year. And then the House appropriations committee refused to give Interior the money, holding it should come from funds for the naval petroleum reserves.

The House armed services committee refused to agree to the retransfer after it heard the Navy's plans. The committee agreed that it would be highly desirable to have additional fuel supplies available on the West Coast.

Two bills which would start the Navy on its experiment have been put in. The bills will be taken up by the committee for hearings late this month. Best guess: The Navy will get the green light.



BY TESTING the mud stream, this new device . . .



. . . gives this kind of record to drilling crews.

With automatic and continuous recording . . .

New Tool Keeps Eye on Mud Properties

LOS ANGELES.—Drillers may soon get more protection against blowouts and lost circulation.

A new device ready to go on the market gives automatic, continuous recordings of weight, viscosity, gel strength, and temperature of drilling mud as it circulates from the hole. Called the Mud Monitor, it has already been successfully tested in the field.

The conventional method of spot checking muds with hand instruments has a number of flaws. It doesn't test the mud under actual drilling conditions since the sample cools off before the test is completed. And samples usually are taken only once in 8 hours.

This means hand testing can be misleading if the slug tested is not typical of the entire system. A slug heavy enough to break down the formation, or one too light to hold formation pressure, can be missed completely.

During critical periods hand samples might be taken several times an hour, but this ties up a member of the drilling crew and it still doesn't insure a uniform mud.

The Mud Monitor, by providing a constant and complete picture of mud properties, can eliminate most of these flaws. Here are some ways in which it can help the driller:

. . . Potential blowout conditions and conditions leading to loss of circulation show up on the recording graph soon enough to be corrected before trouble occurs.

. . . Rate of adding chemicals to the mud can be maintained closer to the correct level. So can mud pumpability. And continuous treatment is less costly than treating back after viscosity or weight has built up too high.

. . . Slugs can be treated individually since a light or heavy slug shows up in a recurring pattern on the recording. This also applies to slugs with high or low viscosity.

How it works . . . The Mud Monitor was developed by Erb & Gray, a Los Angeles instrument-making firm. It picks up mud from the mud-discharge line. A specially designed constant-rate pump circulates the mud through a 10-ft. coil of small tubing.

The monitor samples the mud stream only while mud is circulating. The recorder operates at all times, but no record is produced when mud flow is stopped. A complete record of circulation time is provided.

A pneumatic force-pressure transducer, actuated by the mud in the tubing, measures weight of the mud. One pen of the recorder plots the weight in either pounds per gallon or pounds per cubic foot.

Another pen measures viscosity, the resistance of flow through the tubing. This is the mud's pumpability, measured under approximate mud-ditch conditions.

At 55-minute intervals the mud-circulating pump is stopped for a gel-strength test. The pressure drop which occurs with the shutdown shows the mud's initial gel strength. The peak pressure recorded when the pump starts up again and breaks circulation after the 5-minute shutdown is the mud's 5-minute or final gel.

A thermometer in the flow line determines temperature of the mud and the information is recorded on the 24-hour chart.

Because samples taken by the Mud Monitor closely parallel actual conditions in the mud-circulating system, the measurements reflect the true state of the mud more accurately than conventional methods. This is particularly true of the gel-strength test, which actually measures the force necessary to break circulation.

The Mud Monitor requires little at-

tention. Excessive mud crust, viscosity, or gel don't affect its operation. If its flow system plugs up, it automatically bleeds air from a pressure chamber, preventing excessive pressures from developing. A warning device lets the operator know when a malfunction occurs or when the limit for any mud value is exceeded.

Other benefits . . . The Mud Monitor could conceivably be used as a guide for setting pipe since it will indicate gas or high-pressure oil shows with a sudden dip in the recorded mud weight.

If the line charting mud weight dips to a low level and stays there, it could indicate a potential blowout. A sudden rise in viscosity might mean that a high-pressure salt-water flow, which could also cause a blowout, has been tapped.

Evidence indicates that cutting across a fault plane may cause a change in the temperature curve, giving the operator a clue to the geology of drilled formations. The temperature-change information could also be useful when temperature-sensitive fluids, such as oil-base muds, are being used.

From the temperature chart, the operator can determine the time required for mud at the bottom of the hole to reach the surface after a shutdown. This information, and that from peaks and valleys on the recorded viscosity line, tells how long it is taking the mud to circulate through the system.

By knowing this, the operator can determine whether mud is channeling in the pits. He can also calculate hole volume and detect abnormal hole enlargement.

On the chart . . . The accompanying section of a 24-hour recording made at a field test near Los Angeles shows how the information is plotted.

The fluctuations in mud weight shown on the chart are probably typical. The fact that heavy and light spots show up for several cycles—indicating nonuniform mud—could be a clue to otherwise unexplained blowouts and loss of circulation at other wells.

Fluctuations in the viscosity line indicate that the mud was not uniform. The recurring peak reading at 45-minute intervals shows the round-trip time of the mud. Breaks in this line, and the one recording weight, occur when the pump is shut down for the hourly gel-strength tests.

The weight tracing shows that the mud weight did not fluctuate as widely as the viscosity. It did generally follow the viscosity, however, with a continuous variation of about 2 lb. per cubic foot.

The temperature plot shows a gradual rise. It reveals shutdown time at 2:18, 4:00, and 6:52 a.m.

Gel strength of the mud is indicated at five points: 2:30, 3:37, 4:48, 5:57, and 7:07. Initial gels ranged from 1 to 3 units. The 5-minute gel ranged from 15.5 to 23 units.

The gel-strength readings correlated well with shearometer and Stormer readings. Since arbitrary units are used for measuring viscosity on the Mud Monitor chart, the plotted record does not give viscosity in the usual terms.

Under a given set of circumstances, however, correlation with other types of viscosity measurements can be quickly established. Since viscosity readings are obtained under approximate mud-ditch conditions by the Mud Monitor, they are believed to be less influenced by density and gel strength.

The big drop in temperature, recorded on the chart at 4 a.m., occurred when the pump was shut down for close to half an hour. This is indicated on the viscosity and weight lines by a wider break than that recorded for the hourly shutdowns for gel-strength tests.

Petro-Tex Doubles Butadiene Output

HOUSTON.—New production facilities at Petro-Tex Chemical Corp.'s butadiene plant here have gone into operation.

The expansion, together with other modifications, increases the capacity from about 90,000 to 200,000 tons a year.

Increased capacity of the sprawling plant far exceeds the 5-year goal announced just 2 years ago. Shortly after Petro-Tex purchased the facilities from the Government in 1955 plans were announced for a 50 per cent expansion over a 5-year period *(The Oil and Gas Journal, May 30, 1955, page 55)*.

Petro-Tex is owned jointly by Food Machinery & Chemical Corp. and Tennessee Gas Transmission Co. The parent companies paid $27,197,000 for the plant, which was one of several built by the Government under the World War II emergency program. The companies have spent $30,000,000 expanding the plant.

A major portion of the expanded output will go to the recently enlarged Goodyear Tire & Rubber Co. plant adjacent to the butadiene facilities. The Goodyear plant, as a result of the recent expansion, is now the world's largest single producer of dry-type synthetic rubber *(The Oil and Gas Journal, May 6, 1955, page 92)*.

Normal butane used as feed stock will come from the nearby fractionation plant operated by Tennessee Products Pipe Line Co. This T.G.T. subsidiary pipes butane and other products from a natural-gasoline plant near Banquete, Tex., near Corpus Christi.

Quota Fight Steams Up

Coal, residual-oil interests get into act during wait for administrative move; limited imports to get study

WASHINGTON. — Congress kept the oil imports pot boiling last week while domestic producers waited to see what the administration will do.

Members from the coal-producing areas lived up to expectations with blasts against more delay. Sen. Matthew M. Neely of West Virginia summed up their feelings with caustic comment on "the merry-go-round of investigation."

A suggestion from Sen. Joseph C. O'Mahoney of oil-producing Wyoming that tariffs rather than quotas be used to keep imports down was sent to the White House by Mobilization Director Gordon Gray.

The suggestion "has obvious attractions and advantages," Gray told O'Mahoney. But his own responsibility does not extend to deciding what shall be done if the President finds that imports threaten national security, he reminded the senator.

"I anticipate that there will be opportunity for careful examination of alternative solutions in connection with and following the investigation which the President is expected to authorize," Gray said.

Neely jabs Ike . . . Gray was less happy over a letter from Neely criticizing the failure to include residual oil when thinking of import restrictions.

"It indicates that the President has little, if any, understanding of the peril, inherent in excessive shipments of residual oil to American fuel markets," Neely wrote, "or little compassion for the coal and railroad workers whose livelihood has been irreparably injured by the torrent of residual oil flowing from the Caribbean."

Neely pointed out that although the President promised in 1955 to restrict imports their level has constantly risen.

"Either the administration never did plan to take effective action against the oil cartel to protect the national security or if it did then 'the native hue of resolution' long since became 'sicklied o'er with the pale cast of thought,' " he said.

Neely's outburst didn't meet with much encouragement. He might have a point to argue on residual oil, ODM conceded. But the administration is now committed to action on crude imports, it was pointed out. It has taken the first step under Section 7 of the Trade Agreements Act.

What may happen . . . The machinery of the national security clause having been started, it can be stopped only by action of the President. He may find that imports do not threaten our security. But if he finds otherwise he will have to do something about it.

The possible courses open to the President have been outlined by informed sources:

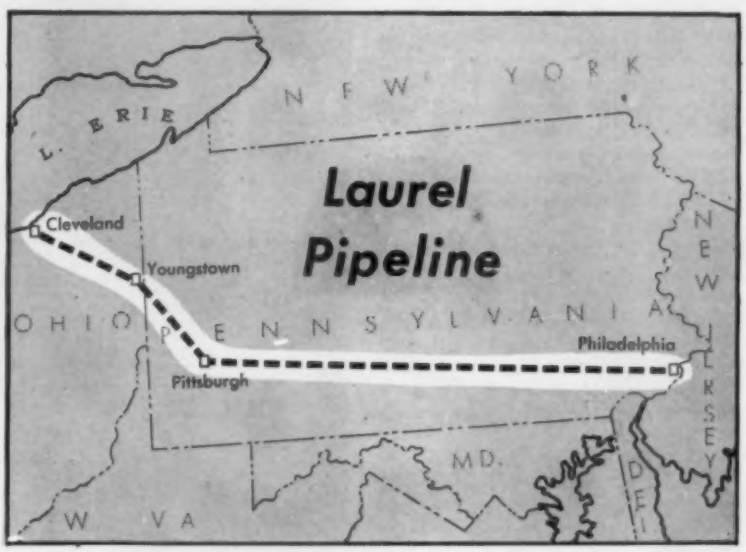
He can try for voluntary action, if he finds that still feasible.

He can invoke quotas, as has been urged by Congress.

He can work out something along O'Mahoney's suggestion of tariffs.

Considered likely of study if formal action is found necessary is an idea which has been before the ODM for some time. This calls for limited imports, tied to refinery runs.

Such a system would take care of the "newcomers" as well as the long-established importers. Imports would be set at a percentage of refinery runs. Any refiner could import up to that percentage. Allowable imports would be figured on an immediately preceding period and would be revised quarterly.



With 100,000-bbl. products line:

Refining Center Getting Help

PITTSBURGH.—A new products pipeline—the first to use 24-in. pipe—will be built from Philadelphia to Cleveland by Gulf Oil Corp., Sinclair Pipe Line Co., and The Texas Co.

Laurel Pipe Line Co., with Gulf owning 40 per cent, Sinclair 35 per cent, and Texaco 25 per cent, has been organized to build the 440-mile line.

The line, to have initial capacity exceeding 100,000 bbl. daily, will be built in 1958, according to an announcement by the companies. It will be 24-in. from Philadelphia westward for 100 miles and graduate down to 14-in. by the time it reaches Cleveland.

The capacity could be increased sharply by adding horsepower to the original four stations or building new stations.

Cost of the project will be $50 million. The pipe—76,500 tons—will be fabricated by National Tube Division of U. S. Steel Corp. at McKeesport, Pa., and Lorain, Ohio.

Pipeline space in this area has been at a premium for some time, both moving west from Philadelphia and east from Chicago. The existing lines across Pennsylvania are proving inadequate. Sinclair has smaller diameter lines running west, and these have operated at full capacity. Space was particularly critical during the winter.

Gas Deal Brewing

El Paso seeking Husky's output in Savanna Creek

CALGARY.—El Paso Natural Gas Co. and Westcoast Transmission Co., Ltd., are dealing for the gas production of Canadian Husky Oil, Ltd., in Savanna Creek field.

Husky holds 32½ per cent interest in Savanna Creek. If the deal is completed, this production would be dedicated to Westcoast.

Glenn E. Nielson, Husky president, said El Paso Natural has offered as part of its proposal to buy the gas to advance $2 million toward Husky's share of development costs in the field. This advance would be repaid from half the proceeds received by Husky from Savanna Creek gas sold to Westcoast. El Paso also has agreed to advance Husky an additional $3 million. This sum would be repayable in Husky stock at the option of either party.

Westcoast already has a contract with Phillips Petroleum Co., owner of a 27½ per cent interest in Savanna field.

Price to be paid for the Husky gas has not been announced. But it reportedly would be at least as large as that paid any other western Canadian producer. Volume of gas involved in negotiations also was not disclosed.

Westcoast will build a pipeline from Savanna Creek across British Columbia. Besides serving Canadian communities, the line will supply Pacific Northwest Pipeline Corp., a subsidiary of El Paso Natural.

Drilling Contractors Merge

NEW ORLEANS.—Merger of Trans-Tex Drilling Co., Shreveport, and Rimrock - Tidelands, Inc., New Orleans, is expected to become effective by the end of this month. The proposal has been approved by directors of the two companies.

Rimrock - Tidelands would be the surviving company, according to an announcement by W. O. White, Trans-Tex president, and H. L. Rowley, chairman of Rimrock-Tidelands. Headquarters would be at Shreveport.

Trans-Tex is a wholly owned subsidiary of Husky Oil Co., Cody, Wyo.

George E. Buchanan, Trans-Tex chairman, would be chairman of the new company. The merger plan calls for election of Rowley as president and White as vice president in charge of land and production. W. C. Kneale, president of Rimrock-Tidelands, would be vice president in charge of exploration.

Processing briefs

Houdry Process Corp. has secured a government guarantee of dollar exchange for royalties from the Societa Arionaria Raffinazione Oilii Minerali (SAROM) of Italy. Houdry has licensed the Italian refining firm to use its Houdriforming process. It is to receive royalties of not less than $135,000 over a 1-year period.

The International Cooperation Administration has guaranteed that if Houdry should be unable to convert the royalty payments from lire into dollars through regular foreign-exchange channels, the Government will provide the dollar exchange up to a limit of $75,000.

Greece's new 30,000-bbl. refinery is expected to go on stream in mid-July. The plant is being built for the Greek Government by Hydrocarbon Mineraloel, G.m.b.H, Dusseldorf, at Aspropygros 12 miles west of Athens. A 14-mile, 12-in. pipeline will connect the plant to storage facilities already built at Megara on the Bay of Eleusis. It will operate on imported crude.

The first U.O.P. Platforming unit in Latin America has gone on stream at the new 25,000-bbl. Havana refinery of Cia. Petrolera Shell de Cuba, S.A. A 5,500-bbl. unit, the Platformer is processing naphthas derived from the Venezuelan Lagomar and Oficina crudes. It is designed to produce 97 leaded octane blending component. It was licensed by Universal Oil Products Co., which also did the design and engineering work.

Cities Service Oil Co. is planning a 100,000-bbl. L.P.G. underground-storage cavity in Dora Roberts field in Midland County, Texas.

The cavern will be leached out of a salt formation underlying the company's Dora Roberts 16 lease at about 2,300 ft. Products from the new Dora Roberts gasoline plant will be stored in a cavity leached from the salt between 2,300 and 2,800 ft. Quick approval of the Texas Railroad Commission is expected.

Lummus Co. will build three 60,-000,000-lb. ethylene-oxide plants, the first to use Shell Development Co.'s direct oxidation process.

Plants will be built for Wyandotte Chemical Corp. at Geismar near Baton Rouge, La.; Calcasieu Chemical Corp., affiliated with Petroleum Chemicals, Inc., at Lake Charles, La.; and Petroleum Chemicals, Ltd., a Royal Dutch-Shell affiliate at Partington, England. Wyandotte and Calcasieu will make ethylene oxide and ethylene glycol.

Ethyl Corp. will build a distribution terminal for Ethyl antiknock compound at Everett, Wash., to serve the growing number of refineries in the Puget Sound area. The terminal, to be ready for operation this summer, will be served by the Port of Everett and Great Northern Railroad.

Canadian Petrofina, Ltd., disclosed plans to increase the capacity of its Pointe - aux - Trembles refinery near Montreal from 20,000 to 30,000 bbl. per day. President A. F. Camp made the announcement at the annual meeting.

Phillips Petroleum Co. will begin operations at its newest catalytic cracking unit early in July. The new unit will replace the 1,200-bbl. thermal cracking facilities at Phillips' 2,700-bbl. refinery at Great Falls, Mont. It was installed by Procon, Inc., Chicago, at a cost of about $1 million.

Also for Refiners . . .

Oil is being produced from the nation's first shale-oil pilot plant using new Swedish extracting process (P. 77) . . . Tidewater and Indiana Standard plan to introduce higher-octane premium gasolines later this month (P. 81) . . . Southern Natural Gas is moving into refining with purchase of Suntide's 65,000-bbl. refinery at Corpus Christi (P. 84) . . . O.C.A.W. has abandoned its 27-cent hourly wage-boost demand and is trying to settle for 5-6 per cent increases (P. 86) . . . Petro-Tex Chemical has put new butadiene facilities on stream at its Houston plant, more than doubling capacity (P. 89) . . . Coal and residual-oil interests in Congress are now blasting administration delays in dealing with imports of foreign oil . . . Texaco, Gulf, and Sinclair will join to lay a products line from Philadelphia to Cleveland (P. 90) . . . A new company, Copetrol Oil Refining, plans a 15,000-bbl. refinery near Havana to process Venezuela crude (P. 97).

PLUS THESE TECHNICAL FEATURES: Solving maintenance problems in alkylation can be a tough job. Here's how some typical cases were handled (P. 143) . . . On the Job . . . In the Plants (P. 149) . . . The Foreman's Page (P. 153) . . . and COST-imating (P. 154).

BOARD OF DIRECTORS for Jersey Standard (left to right): Page, Coleman, Soubry, Rathbone, Elliott, Shepard, Boyer,

Here're the Men Who Make Jersey Click

WHO are the men behind Standard Oil Co. (N. J.)?

The most powerful two men in the company are Eugene Holman and Monroe J. Rathbone. Holman is board chairman. Rathbone is president. Together with Leo D. Welch, L. W. Elliott, and E. E. Soubry, they form the executive committee.

These men coordinate the activities of other directors. Each director in turn has one or more areas of company operation as a principal interest.

Holman began his career with Humble in 1919 as a geologist, became its chief geologist, and later served in executive jobs with Venezuelan producing affiliates. Rathbone joined Jersey's organization as a draftsman at Baton Rouge, La., in 1921 after graduating from Lehigh. He headed Louisiana Standard in 1936, Esso Standard in 1944, and Jersey in 1954.

Other board members and their responsibilities are:

Marion W. Boyer, refining and research, former executive vice president of Esso Standard.

Stewart P. Coleman, a vice president and chairman of the coordination committee. He joined Humble in 1920 after graduating from Rice as chemical engineer.

Jay E. Crane, international trade and finance, joined Jersey in 1939 after many years with the Federal Reserve Bank of New York.

Elliott, world-wide exploration. Now a Jersey vice president, he joined Carter in 1916 and is a former president of Standard-Vacuum.

Henry W. Hewetson, Canadian and U. S. affiliates, employe relations and related matters. A Jersey vice president, he joined the company in 1919, became president and later chairman of Imperial.

Peter T. Lamont, marketing, European and North African affiliates. He has been with company since 1922 and formerly was marketing coordinator.

Howard W. Page, Middle East and Far East. A veteran of 27 years in the company, he formerly was executive assistant to the president.

Arthur T. Proudfit, North and South American affiliates, world-wide producing problems. He is a former president of Creole.

David A. Shepard, European, North African, and Middle East affiliates. He moved to a Jersey vice presidency from Esso Petroleum Co., Ltd., where he was chairman.

Soubry, world-wide marketing, certain U. S. and South American affiliates. He also formerly was chairman of Esso Petroleum Co., Ltd.

William H. Scott, U. S. and Latin American affiliates, world-wide marketing problems. He started as products salesman for Esso Standard in 1929 and became marketing coordinator for parent company in 1954.

Welch, vice president for finances, certain South American affiliates, came from First National City Bank.

Jersey Is 75

STANDARD OIL CO. (N. J.) is 75 this year—an advanced age for an American business concern.

But its Diamond Jubilee Year finds Jersey Standard far from decrepit. It's still on the heap in world oil and still growing. Earlier this year, in fact, the company was rated the best managed company in oil by Forbes, national business publication.

What's the secret for this virility and longevity in such a competitive business? It probably stems from Jersey Standard's unusual board of directors. These board members:

. . . Are all working directors. Most of them are graduates of subsidiaries and have spent nearly all of their business careers in the Jersey organization.

. . . Meet with exceptional frequency to examine current problems or make long-range plans.

Heavy on experience . . . All but two of the 14 present board members are life-long oil men.

The two exceptions have years of business experience in areas where the company needs executive talent. These two are Jay E. Crane, formerly deputy governor in charge of foreign business for the Federal Reserve Bank, and Leo D. Welch, formerly vice president of the National City Bank of New York, in charge of South American and Caribbean operations.

Stott, Larson, Hewetson, Crane, Holman, Carpenter, Welch, Proudfit, and Lamont.

Years Old, Going Strong

Crane, however, is completing his term as director and will step down at the annual meeting May 22. He already has retired as a vice president, effective September 1, 1956, when he reached retirement age.

Hines Baker, recently retired president of Humble Oil & Refining Co., has been nominated to succeed Crane. He has been in the oil business since 1919 when he joined Humble's legal department. He was elected a Humble director in 1937, took charge of refining and marketing in 1940, was named vice president in 1944, executive vice president in 1945, and president in 1948.

Daily meetings . . . Tipoff that Jersey Standard's directors are "working" directors is this fact: They meet every week—on Thursday.

But more important the executive committee meets every day. Directors who are in town attend the executive committee meetings so that, to all intents and purposes, there is a board meeting daily.

This extraordinary close attention to business keeps the company resilient. An example is Jersey Standard's advance preparation for what later became the very serious Suez crisis. When Nasser seized the canal last July, the company quickly went to work on plans for alternate routes if the canal should be closed. When that did happen 3 months later, plans were ready and were put right into operation.

The program called for supplying the company's Western European refineries with Western Hemisphere crude up to 50 per cent of their normal Middle East supplies. It also called for stepping up Middle East shipments either through Tapline or around the cape. Tankers belonging to the company and its affiliates were increased from 162 to 190. They were rerouted for greater efficiency on the Middle East-Caribbean-Europe triangle.

Another example of Jersey Standard's flexibility, due in part to its geographic diversity, is its position on imports. This is the industry's most troublesome current problem.

Here is Jersey's position: Its U. S. affiliates together face a deficit in crude. Their combined net production, 436,000 bbl. daily, is well short of their 827,000 bbl. daily runs to stills. But last year Jersey's foreign affiliates produced 1,584,000 bbl. daily of crude.

With domestic demand 391,000 bbl. daily above production and ample foreign crude at its disposal, Jersey still has held its crude imports to less than 80,000 bbl. daily. These imports are well within the 1954 formula recommended by ODM. Furthermore, they are all from Venezuela. This meets another government recommendation that imports from Western Hemisphere sources be stressed in preference to those from more distant, less accessible areas.

This self-imposed curb on large imports of low-cost foreign oil has not been an impossible handicap to the Jersey company. Last year its net profit equalled 18.6 per cent of its invested capital. The other five multi-billion dollar oil companies combined showed a net profit of 16.7 per cent of their invested capital.

Maze of companies . . . The men primarily responsible for decisions that produce these results must pay close attention to affairs of more than 100 subsidiaries or affiliated companies.

The board of the parent company keeps a close check on the directors and executive personnel of each affiliate, considers their appropriations for capital spending, and reviews their financial results.

The directors initiate studies of existing plans and undertakings. They also keep their eyes on relevant non-company affairs. Public leaders and experts in various fields are called in to discuss trends and viewpoints for them.

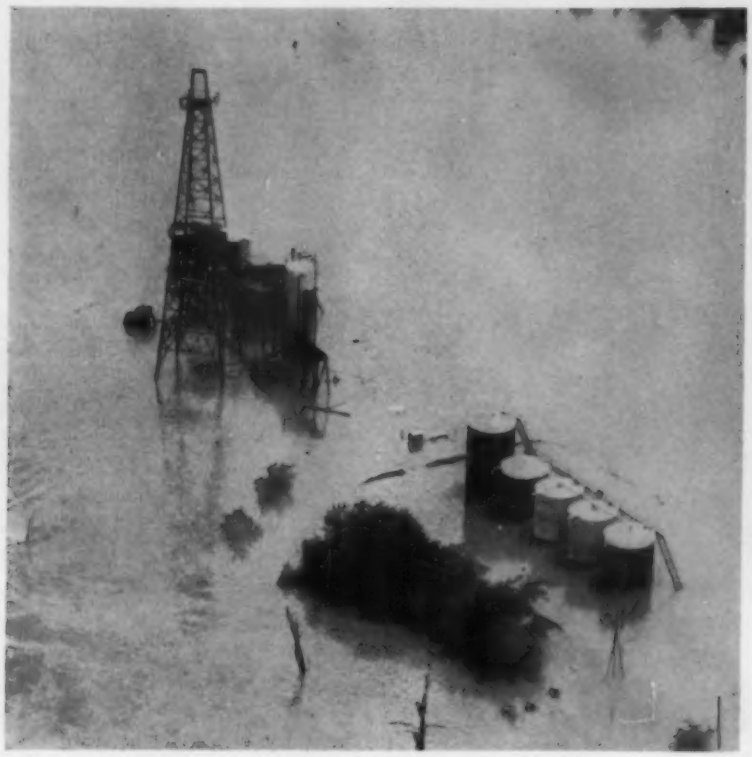
As a result the directors and their staffs are available to subsidiaries for advice and consultation on any conceivable question. At least once a year the Jersey board meets with management of the major operating affiliates to review results and consider prospects.

This system apparently works admirably. It has made Jersey the biggest oil company in the world and the second largest manufacturing enterprise in the United States. Jersey is by far the largest oil company. Its total assets are $7.37 billion, more than the combined assets of the next three largest U. S. oil companies.

Jersey's principal source is dividends from its 100 subsidiaries or affiliates. Last year consolidated affiliates paid in $528,048,000 in this manner. Other sources brought total income to $808,534,919. The affiliates operated in 22 countries.

Most profitable of these affiliates was Creole Petroleum Corp., Jersey's 95 per cent owned Venezuelan subsidiary. Last year it produced 1,081,000 bbl. daily of crude, refined 275,000 bbl. daily, and remitted $276,767,000 in dividends to the parent company.

Other important sources of income were: Humble, $75,627,000; Esso Standard Oil Co., $30,986,000; Imperial Oil, Ltd., $25,483,000; International Petroleum Co., Ltd., $16,193,000. Dividends from the other affiliates totaled $102,992,000.



Stitch in time saves oil as . . .

Flood Soaks East Texas Field

GLADEWATER, Tex. — A bit of foresight has saved thousands of dollars in oil production for producers in this water-logged portion of giant East Texas field

The oil is that which might have been lost during the 3-week rampage of the Sabine River which cuts west-to-east through the thickest part of the field just south of here.

Torrential rains coming almost daily since mid-April rushed the Sabine out of its banks and over an estimated 7,000 acres of the big oil pool at the height of the flood 10 days ago. The river cut about a 2-mile swath through the field.

There are more than 1,000 wells in this area. Last week, water still covered about half the bottom-land acreage. And more than 500 wells still were isolated . . . except by boat. Barring more rain, all wells should emerge in another week.

Despite the large-scale flooding, however, a preliminary check showed the high water caused little damage to oil operations. Losses of allowable production are believed very low.

What operators did . . . Most of the operators in the area are well aware that their wells are apt to be flooded. They prepared long ago for such an emergency by building dikes, raising well heads, relocating flow valves high over the rest of the wellhead connections, and keeping boats handy.

Damage to pumping units was slight since there are few of them in the area. Of East Texas field's roughly 20,000 wells, only 8,000 are on the pump. And the percentage in the north end, the field's best, is much lower.

Operators along the Sabine who do have pumping wells wisely make their allowable as early in the month as possible during wet periods.

Except for a few pumping units, losses were confined mostly to lease roads and some near-empty lease tanks which floated off. Even lease roads weren't hit too hard. Most flooding was by backwater, which had little or no current.

With lease roads flooded boat traffic to and from the wells was heavy.

Injection disrupted . . . The flood did disrupt pressure-maintenance operations in the Gladewater area. Buck Morris, head of the East Texas Salt Water Division Co., said a disposal well there was shut down for 19 days. Flood water overran collection tanks in the area which fed produced salt water to the well.

All pipelines and gasoline plants in the field were able to continue operation. Atlantic Pipeline Co. was forced to quick action, however, to nip a high-water threat at its pump station south of Longview. Water breached a firewall around a 55,000-bbl. tank. There was enough oil in the tank to keep it from shifting immediately, however, and the company was soon able to pump out the surrounding water.

Other fields hit harder . . . Other fields in East Texas, Louisiana, and the Texas Gulf Coast aren't getting off so lightly.

In Pine Island field in Louisiana, lease roads were damaged heavily and a considerable number of pumping-unit motors ruined.

Operators in several Gulf Coast fields in both Texas and Louisiana early last week were still braced, awaiting flood crests of the swollen Sabine, Red, and Trinity rivers.

Oil Scouts Exempt

Court frees them from rules of wage-hour law

TULSA.—Oil scouts are administrators. They were handed this status officially last week in U. S. District Court.

In a precedent-setting verdict, the court ruled that oil scouts are exempt from the wage-hour law which would have placed them on a 40-hour week with time and one-half for overtime.

The test case was filed by the Department of Labor against Midstates Oil Corp. of Tulsa. Its outcome affects all scouts in the industry. There was no indication of an appeal.

The Government contended that scouts could not be classified as administrative employes—and thus be exempt from the wage-hour law—because "they do not use discretionary and independent judgment." The Government conceded, however, that scouts met all other requirements for the classification.

Midstates officials said the suit arose when Labor Department examiners made a routine check of the company's wage-hour records and apparently decided to make a test case of the issue.

Midstates pointed out that oil companies classify oil scouts as executives due to the nature and irregular hours of their work.

Qum May Get Outlet

● Some think a line from this field in Iran's rugged interior to the Mediterranean will be the next built in the Middle East. The big question is: Who will build it?

THE next major crude pipeline in the Middle East may not be the widely publicized projects from Iraq's Kirkuk or the Persian Gulf fields of Saudi Arabia, Kuwait, Iraq, and Iran.

It may tap the Middle East's most spectacular discovery of recent years, the Qum field located in the interior of Iran. A 1,000-mile line to move Qum crude to the Mediterranean is being studied (see map).

Qum blew in several months ago at 80,000 to 150,000 bbl. per day. It spouted a veritable sea of 5,000,000 bbl. of oil before being killed by Myron Kinley, wild-well expert *(The Oil and Gas Journal, September 3, 1956, page 84, and January 21, 1957, page 78).*

Who will exploit Qum? . . . Discovered by the Iranian Government company, National Iranian Oil Co., Qum has become one of the most widely sought concession prizes in the Middle East.

The big international companies with Middle East holdings have steered clear of Qum because they fear it would require more than the normal 50-50 split. But several companies—Americans included—without Middle East holdings are interested in a deal for a Qum concession.

Ente Nazionale Idrocarburi (E.N.I.), the Italian state monopoly, has claimed a deal giving Iran a 75 per cent profit cut for the right to exploit Qum. This Iran denies. E.N.I. has also announced, without Iranian confirmation, that it has made a 75-25 deal for concessions in central and southern Iran and in the Persian Gulf *(The Oil and Gas Journal, May 6, page 94).*

And E.N.I. isn't alone in seeking rights in Qum. But present international companies cannot afford to go beyond the prevailing 50-50 profit split.

The answer to the question of who will win this development prize may be supplied by N.I.O.C. itself, which takes great pride in this discovery credited to British-trained Iranians. N.I.O.C. believes it is fully capable of defining and exploiting the new field.

Where will oil go? . . . The disposition of Qum crude has aroused almost as much excitement as the scramble for concession rights. Will it move north, south, or west?

No less an authority than Wallace Pratt, world-renowned geologist, has said that the facts of economics and geography point straight north — to Russia—as the most logical market. The economic feasibility of piping the crude across the Persian Plateau and Turkish mountains to the Mediterranean has been questioned.

The line to the Mediterranean would be 1,000 miles long and cost $250 million to $500 million.

To the doubters, Middle East pipeliners point to existing lines to the Mediterranean, to the products line which scales the Iranian mountains en route from the Persian Gulf to Teheran, and to two proposed crude lines which would parallel a line from Qum through Turkey *(The Oil and Gas Journal, December 3, 1956, page 66).*

Preliminary survey indicates all of the lines under study would be justified—and all three may be built.

The puzzler about the Qum line is: Who will build it?

A decision must await the drill, and that shouldn't be long in coming. The interested companies on the sidelines are waiting until 6 Alborz is put down, probably before the end of the year. This test will tell whether the strike was a freak or whether a major new Middle East producing area has been tapped.

N.I.O.C.'s insistence on developing Qum complicates the pipeline picture, for transportation revenue alone isn't enough incentive to attract capital for a project of this size. The formula which suggests itself is that the pipeline project—if developments justify it—may be part of a concession package with the builder gaining rights to a new area other than Qum.

Venezuela May Stiffen Bidding

● Government is cracking down on bidders who can't back up bids with money; may require 20 per cent deposit

THE long-on-bids, but short-on-money set may be nearing the end of the road in the race for new oil exploration acreage in Venezuela.

The Ministry of Mines and Hydrocarbons is considering making bidders put up some money when they make an offer for new concessions. The practice of offering a fancy price for Venezuelan acreage in the hope that it can be quickly peddled to an established oil company is growing.

The Venezuelan Government has been more than a little embarrassed in its last two concession offerings to find that newcomers to the country couldn't back up lush bids they made. In most cases they couldn't pay up because established companies refused to come through with the money which the middle men bid.

The ministry is about to require a bidder to submit from 10 per cent to 20 per cent of his bid at the time it is made. If the bid turns out to be high and is accepted this down payment would be applied to the concession price. If not, the deposit would be refunded.

If the winning bidder doesn't come up with the remaining 80 or 90 per cent of the price he has offered—and within the allotted time—he would lose the initial deposit.

The reasons why . . . In the country's first concession offering in more than 11 years, two companies failed to pay for their bids when the money came due last year.

Venezuelan American Independent Oil Producers Association, a newcomer to the country, bid $785 an acre for Lot 10 in Lake Maracaibo. The company failed to put up the money and the government revoked the bid. V.A.I.O.P.A. farmed out a 2,079-acre national reserve lot just off the east shore of Lake Maracaibo to Sun Oil Co., Venezuelan Atlantic Refining Co., and Seaboard Oil Co. The three-company combine put up the entire $1,935,000 which the new group had bid for the acreage. The bidder retained an interest.

In that same acreage offering, Star Oil Co., also a newcomer to the country, bid on a total of 144,600 acres in Lake Maracaibo, the area northeast of Mara field, and in Apure. The total bid was more than $62 million. When the company failed to meet the deadlines on the Lake Maracaibo and Apure acreage, the government canceled the deal on the Mara acreage.

In the second round of bidding early this year, the government specified that successful bidders would have to post the full amount of their bids in approved banks within 8 days after being informally notified of a successful bid. The established companies and one newcomer, King-Mill Oil Co., met these conditions.

Several other new companies, many of them local Venezuelan companies, offered the top bids for acreage in several areas of the country. When they were informed they were successful bidders, most of them hurriedly offered the acreage to other companies in Venezuela or attempted to obtain financing in the United States. Latest reports from Caracas indicate they were not successful. None of the offers have yet been published in the Gaceta Oficial.

Forest Closes Deal in Cyprus

AFTER dickering for more than a year, an American independent oil company last week walked into one of the world's tenderest political hot spots to hunt for oil.

Forest Oil Corp., an old-line Pennsylvania company which has recently shifted much of its attention to Texas from Bradford, Pa., will look for oil on the island of Cyprus.

Forest has a 2-year exploration license covering the entire island (3,572 sq. miles) and its territorial waters. Active exploration work is expected to begin by midsummer this year.

Few spots on the face of the globe can challenge any claim Cyprus might make for the most political violence per square foot. The island, third largest in the Mediterranean, is 40 miles south of Turkey, 60 miles west of Syria, and 240 miles north of Egypt. It has been under British administration since 1878.

Cyprus has become strategically important to the British since the English began losing one foothold after another in the Eastern Mediterranean. In conflict with this British interest in hanging on to Cyprus, Cypriotes have intensified their opposition to British rule.

Four-fifths of the Cyprus population is Greek Christian and the other one-fifth, Turkish Mohammedan. Each group would like to see the British leave. In the past 2 years they have emphasized their feelings along these lines by killing each other and the British.

Previous search . . . It was this situation that Forest faced last week when it started to take up where Iraq Petroleum Co. quit years ago. I.P.C. spent at least $500,000 on a 2-year seismic and surface geological program on Cyprus which ended in 1949. The American company apparently has had access to the I.P.C. findings.

Forest's first interest in Cyprus became apparent in February 1956 when Forest E. Dorn, chairman of the company, visited the island accompanied by Norval E. Baker, New York consulting geologist who was chief geologist for I.P.C. when the latter company's work was done on Cyprus.

Ike Backs Aramco

President hints question on Arabian taxes is dead

PRESIDENT EISENHOWER last week added the weight of his office to U. S. tax policies which have relieved Arabian American Oil Co. from paying U. S. income taxes in addition to the taxes it pays in Saudi Arabia.

The practice has come under fire in the Senate. Criticism leveled at the company prompted a formal statement of defense from Aramco last month *(The Oil and Gas Journal, April 29, page 117).*

In his press conference last week, the President was asked if he had talked with Secretary of the Treasury Humphrey about Aramco's taxes. He said he had and then explained that the situation was well covered by U. S. tax laws.

Taxes paid by an American company in a foreign area are deducted from the taxes paid by the company in the U. S., the President explained. He said the Bureau of Revenue was called on to decide in 1950 whether the Saudi Arabian tax was only more royalty or a bona fide tax. He said the revenue service decided it was a bona fide tax.

In his reply to questions, the President indicated that as far as he is concerned that ends the question of Aramco's taxes.

Island Terminal Opens for Business

THIS still-incompleted marine terminal 3½ miles east of Bombay is handling deep-water tankers unloading crude for India's two largest refineries.

Being built by Netherlands Harbor Works Co., Indian subsidiary of the Royal Netherlands Harbor Works Co., Amsterdam, the terminal will serve the 40,000-bbl. daily refinery of Burmah-Shell Refineries, Ltd., and the 27,800-bbl. daily refinery of Standard-Vacuum Refining Co. of India.

The facility is being built in a natural deep-water site at Butcher Island and will cost the Bombay Port authority more than $21 million. It will accommodate three tankers of up to 34-ft. drafts at one time.

The L-shaped jetty is 1,600 ft. long. Two of the three berths are completed, with the third expected to be completed soon. The terminal is linked to the Stanvac and Burmah-Shell refineries by six submarine pipelines, three of them 24-in. crude lines. A 12-in. and 16-in. line will be used to move finished products back to the terminal for tanker shipments to other Indian ports. An 8-in. line will move fresh water to the island terminal.

Paria Bids Net $100 Million

A COMBINE of five American oil companies paid Venezuela bonuses of $100 million for the right to look for oil under 148,200 acres of untested land off the east coast of the country.

The bonus bids for six blocks in the Gulf of Paria averaged about $670 an acre. The concession lies under water which averages about 80 ft. in depth.

The Ministry of Mines and Hydrocarbons previously revealed that bonuses on three of the six blocks totaled more than $46,600,000 *(The Oil and Gas Journal, May 6, page 96)*.

The companies are Continental Oil Co., The Texas Co., and Ohio Oil Co., each with a 25 per cent interest in the operation; Cities Service Oil Co. with 16⅔ per cent; and Richfield Oil Corp. with 8⅓ per cent. Richfield is controlled by Sinclair Oil Corp.

One of the five will act as operator for the entire group, but there had been no decision last week on which it would be.

Other acreage . . . The group's new acreage represents the biggest single bid involved in the race for the almost 356,000 acres in the Gulf of Paria offered by the Venezuelan Government last February. Three other companies made what were apparently successful bids on single blocks in the same area. The prices they offered have not yet been disclosed *(The Oil and Gas Journal, March 25, page 118)*.

The acreage in the gulf is located north of the onshore field of Pedernales, which accounts for about 11,000 bbl. daily of Venezuela's production. It is west of Soldado field in Trinidad water, where Trinidad Northern Areas, Ltd., has drilled two producers from the same offshore platform.

Turkish Test Staked

Tidewater to drill on big block in Raman field area

TIDEWATER OIL CO. will become the fourth American company to drill in Turkey under the new oil law when it starts a well this summer near the Iraqi-Syrian border.

The company will be the operator on acreage held jointly with Atlantic Refining Co. and Seaboard Oil Co. Their concession blocks total more than 3,000,000 acres, mostly along the southern border.

The well will be located near Mardin, south of Turkey's only production at the 5,500-bbl. daily Raman field. Location is northwest of production in northern Iraq.

International Brown Drilling Corp. of Los Angeles will be the contractor on the test. A rig capable of going to 15,000 ft. will be shipped from Houston.

Esso Standard (Turkey), Inc., was the most recent company to spud in the country. It is drilling a well in Thrace, European Turkey, where Tidewater, Atlantic, and Seaboard also hold 300,000 acres.

A Caltex affiliate is drilling a test a considerable distance west of the Tidewater site in southern Turkey. Turkish American Oil Co. is drilling a slant-hole test under the Gulf of Iskenderun on a farmout from Gilliland Oil Co. *(The Oil and Gas Journal, May 6, page 95)*.

Cuba to Get New Refinery

A newly organized company, Copetrol Oil Refining Co. of Havana will build a small refinery in Cuba to process Venezuelan crude.

Design and construction contracts were let to Grebe & Doremus Process Co. of Houston. The firm is now making economic studies and appraising potential sites for the plant.

The refinery will have a capacity of 10,000 to 15,000 bbl. per day and cost about $6,000,000. Construction is expected to start late this year.

Part of the products will be sold to Cuban markets, but a large percentage is expected to be exported. Copetrol is headed by Angel Pagliuca of Havana and New York City.

The authors believe high rates of injection are not

In recent years, there has been a rapid increase in the application of secondary water flooding as a means of obtaining additional oil from substantially pressure-depleted pools. Concurrently, an extensive search has been conducted for a better understanding of the factors that affect the recovery of oil by this process and contribute to the success of a water flood. Special attention has been devoted to the effect of rate of water advance on the ultimate recovery of oil.

In January 1950, Forest Oil Corp. in a hearing before the Railroad Commission of Texas requested unlimited allowables and exemption from shutdown for a water flood on certain leases in South Ward field, Ward County, Texas. At the hearing, technical witnesses presented evidence alleged to show that unrestricted production for such operations is necessary to prevent waste, i.e., loss of recoverable oil. Their principal technical arguments were that:

1. Restriction of water injection on three cited water-flood properties resulted in loss of ultimate oil recovery.

2. A reduction in the rate of water injection in formations comprising strata of variable permeability results in bypassing large quantities of oil in low permeability or tight sections of a sand and, conversely, high injection rates result in high oil recovery.

3. Migration of oil from one property to another is possible if wells are not produced at capacity.

Commission action . . . On the basis of their testimony, the Railroad Commission granted the request for capacity allowables. Subsequently, the pattern established in South Ward field became quite general, and unlimited allowables were granted by the commission on statement of ability to produce. As of January 1, 1956, there was about 100,000 bbl. per day of unrestricted secondary-recovery waterflood production in Texas.

At the time of the South Ward hearing, little note was taken in the industry of the evidence presented in support of the request for unrestricted production or of the granting of this request by the commission. However, as the number of capacity water floods has increased, the production from such operations has assumed greater significance.

I.O.C.C. hearing . . . In December 1953, the Secondary Recovery and Pressure Maintenance Advisory Committee of the Interstate Oil Compact Commission was requested to make a study of the

Effect of Rate on Oil Recovery

by J. K. Jordan, W. M. McCardell, and C. R. Hocott

NUMEROUS requests have been made to the Railroad Commission of Texas for unlimited allowables for secondary water floods on the grounds that such producing conditions are necessary to prevent loss of recoverable oil. This paper presents the results of a comprehensive investigation conducted to determine the influence of flooding rates on ultimate oil recovery from secondary water floods.

From examination of the performance of actual floods, extensive search of the technical literature, theoretical and laboratory studies of the fundamental physical factors involved, and critical analysis of the evidence presented by proponents of high rate floods, the following conclusions are made:

1. High rates of injection with capacity production are not necessary to obtain maximum ultimate recovery.

2. Water floods can be curtailed without loss of oil recovery.

3. In natural reservoirs, which usually comprise heterogeneous formations, reduction in the rate of water advance may enhance recovery as a result of the action of capillary forces to produce more uniform flooding.

Field water floods . . . The most direct source of information on the influence of rate on water-flood recovery lies in the history of completed floods. However, floods in different fields cannot be directly compared, nor can floods in different parts of the same field, because of variation in reservoir characteristics and oil saturations.

Floods which have been subjected to curtailment provide conclusive information only if prediction can be made of the recovery which would have been obtained had they not been curtailed. The method of prediction of the "uncurtailed recovery" most often used is extrapolation of decline curves. Study of field examples reveals that this method cannot be used indiscriminately to predict the performance of floods and that conclusions based upon such predictions must be considered subject to question.

The information contained in field production histories is better revealed in graphs of cumulative oil and total fluid production versus cumulative water injected. No evidence that large changes in injection or producing rates affected the oil recovery could be detected from study of such graphs. Several authors have published analyses of floods which show that voluntary curtailment of floods to take advantage of the economics of flowing production did not result in loss of recoverable oil.

Laboratory data . . . In the laboratory, experiments can be conducted under controlled conditions to provide direct comparison of the effect of flooding rate on recovery. Extensive experimentation in homogeneous sands reveals that either with or without the presence of a gas phase the quantity of oil which can be displaced from those portions of the rock invaded by water is not dependent upon the rate of displacement within the

PRODUCING

necessary . . . that water floods can be curtailed

effects of curtailment of production on oil recovery from secondary water floods. The interest of the Interstate Oil Compact Commission in this matter is prima facie evidence of its importance to the industry and to state regulatory bodies.

The following December, Dr. George H. Fancher, chairman of the appointed subcommittee, reported[1] that there was such diversity of opinion concerning the effects of rate on recovery that the subcommittee was unable to make any recommendations or to present definite conclusions on the subject. The fact that this technical subcommittee did not present a conclusive report is indicative of the difficulty of the problem.

Humble's study . . . In view of the impact that unrestricted production may have on the industry and of the lack of general agreement within the industry on the technical aspects of capacity secondary water floods, Humble's production research division undertook an extensive study of the problem. We believe that sufficient evidence is available to establish a sound technical description of the effect of rate on oil recovery by water flooding.

Further, we conclude firmly that for the **range of normal field rates** the recovery of oil from secondary water floods is not adversely affected by curtailment of rate. The purpose of this report is to present pertinent field and laboratory studies and to provide as clear a picture as possible of the relation between rate and ultimate recovery of oil by secondary water flooding.

An extensive search of the literature was made to accumulate reported facts and experience. One of the outstanding reference volumes on the subject of secondary recovery is the report of the American Petroleum Institute's Standing Subcommittee on Secondary Recovery Methods published in 1950.[2] The principal sources of relatively complete data for the history of floods are the publications of the Bureau of Mines. A limited amount of useful field data has been published by the A.I.M.E., A.P.I., and a number of water-flood associations. A majority of pertinent research results is to be found in the Transactions of the A.I.M.E. Our search included these sources and also the various trade journals, reports of the Interstate Oil Compact Commission, and testimony presented before the Texas Railroad Commission. Some additional experimentation conducted in the division's laboratories is also reported.

by Water Flooding

. . . as determined by reviewing histories of completed floods . . . and from laboratory analyses

range of rates normally occurring in field operations.

However, the uniformity of flooding of heterogeneous formations, which make up all known reservoirs, does depend upon the flooding rate. The operator therefore is free to select the rate of flooding which will insure that the maximum portion of the reservoir is invaded before abandonment. It is anticipated from theoretical considerations and confirmed by laboratory experiments that increased uniformity of flooding of heterogeneous formations occurs at flooding rates sufficiently low to permit the imbibition of water into low-permeability strata by capillary forces.

Restriction of flooding rate, therefore, does not result in loss of recoverable oil but rather may actually enhance recovery. These principles are the same as those which have been recognized for many years in the control of rate of advance in natural water-drive fields.

Problems of oil migration to adjacent properties, which in some in-

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stances may make it desirable to maintain low pressure at the producing wells, do not necessitate unlimited flooding rates. Reduction of the reservoir pressure can be accomplished as satisfactorily by reducing the rate of water injection as by increasing the rate of fluid production.

The Displacement Process

The proper interpretation of water flooding as a secondary means of oil recovery rests upon a framework of thorough understanding of the fundamental principles underlying the mechanism of the displacement of oil by water. Such a framework has gradually been built by the efforts of many investigators who have made extensive studies both in the laboratory and in the field concerning the mechanism of oil recovery and the numerous factors that influence the recovery of oil from underground porous rocks.

Today the reservoir engineer can make a quantitative appraisal of a particular oil reservoir, its properties, its fluid contents, and the type of natural drive available. He can then select a suitable recovery process and control that process for maximum efficiency in the extraction of the oil. Wide-spread application of sound reservoir technology in an atmosphere of conservation has resulted in increased oil recovery.

Natural Water Drive

Efficient recovery of oil from a reservoir operating predominantly under a natural water drive requires that the invading water advance uniformly into and through the oil-bearing formation, flushing oil effectively from all parts of the rock. The rate of water advance depends upon the pressure drop between the oil-filled and water-filled zones, and upon the permeability of the rocks through which the water moves. The pressure drop is determined by the rate at which oil, gas, and water are removed from the reservoir.

Since the operator can exercise deliberate control over the rate of production, he can, in large measure, assure efficient recovery of oil from a natural water-drive reservoir. The A.P.I. Special Study Committee on Well Spacing and Allocation of Production[3] stated that:

"Production rate is one of the most important factors governing oil recovery, and production at excessive rates commonly causes waste."

According to Buckley[4] in the book, Petroleum Conservation:

"Excessive rates of withdrawal lead to rapid decline of reservoir pressure, to release of dissolved gas, to irregularity of the boundary between invaded and noninvaded sections of the reservoir, to dissipation of gas and water, to trapping and bypassing of oil, and, in extreme cases, to complete loss of demarcation between the invaded and noninvaded portions of the reservoir, with dominance of the entire recovery by inefficient dissolved gas drive. Each of these effects of excessive withdrawal rates reduces the ultimate recovery of oil."

Studies of the performance of many natural water-drive fields have established that control of the rate of water advance by restricting the rates of production has resulted in high primary oil recoveries. Not only has physical waste been avoided, but flowing production has been sustained for a long time before resorting to more costly artificial lift methods.

Secondary Water Flooding

In secondary water flooding, the mechanism of displacement of oil by water from the individual pore spaces is identical with the displacement mechanism occurring during the natural water-drive process. Buckley[4] stated:

"The same types of control must be exercised to insure efficient flushing of the reservoir. The employment of injection wells localizes the area of access of the water, and imposes a geometric limitation that is not encountered in a natural water drive. However, this handicap is offset, in part, by the positive control over the rate at which water is supplied to the producing formation, and by the fact that it is possible to control to some degree the relative rates of injection into strata or layers of different permeability."

It is pertinent, then, in any consideration of the subject of secondary water flooding to review those principles fundamental to the recovery process whether it be by primary or by secondary methods and to draw upon the experience and conclusions of workers in reservoir performance. The following discussion presents the more important factors that influence oil displacement and may assist toward an understanding of the secondary water-flooding process as a recovery mechanism.

Permeability . . . Effective displacement of oil from the formation is influenced considerably by the degree of continuity and uniformity of the producing formation. If maximum recovery of oil is to be obtained, oil must be displaced from all parts of the gross productive formation. However, naturally occurring oil sands rarely are uniform in permeability and other physical properties. Their nonuniformity may occur as stratified layers of differing permeability or as sand lenses having permeabilities different from that of the main body of the formation.

These variations in formation permeability hamper control of effective displacement. Heterogeneity of the formations to be flooded can lead to considerable difficulty in the maintenance of a uniform displacement pattern. If the displacement of oil by water is not uniform, water may appear prematurely at producing wells and result in early abandonment of the project. Muskat[5] states that other variables that may affect sweep efficiency are minor compared to the effect of large variations between the maximum and minimum values of reservoir permeability.

To illustrate the influence of variations in permeability on the efficiency of oil recovery by water flooding, the injection and production data for Cable Oil Co.'s J. S. Webb flood in Webb pool, Archer County, Texas, are presented in Fig. 1. Grandone, Jessup, and Taliaferro[6] described this pool as a sand body of nonuniform permeability. The performance curves for this flood exhibit the early water breakthrough and continuously increasing water-oil ratios that are typical of nonuniform displacement in heterogeneous sands.

Capillary forces . . . In the small pore spaces in which oil is normally found, the surface forces that act at the interfaces between gas, oil, and water are important. In heterogeneous formations containing sands of variable permeability, the role of capillary forces in influencing the flooding pattern is more significant than in uniform sands.

Initially the reservoir is in capillary equilibrium, with the tight sands containing higher water saturation than the more permeable sands. As water advances into the reservoir, the water saturation increases, and capillary forces seek to attain a new equilibrium. The tight sands imbibe water to maintain higher water saturation than adjacent sands of higher permeability.

To flush all parts of a heterogeneous formation efficiently, it is important to take advantage of capillary effects by permitting the water to advance at such a rate that it penetrates and expels oil from the tight sands as well as the more permeable sands. If the pressure gradients caused by production are too high, the equalizing effect of the capillary forces cannot take place to an adequate degree, and

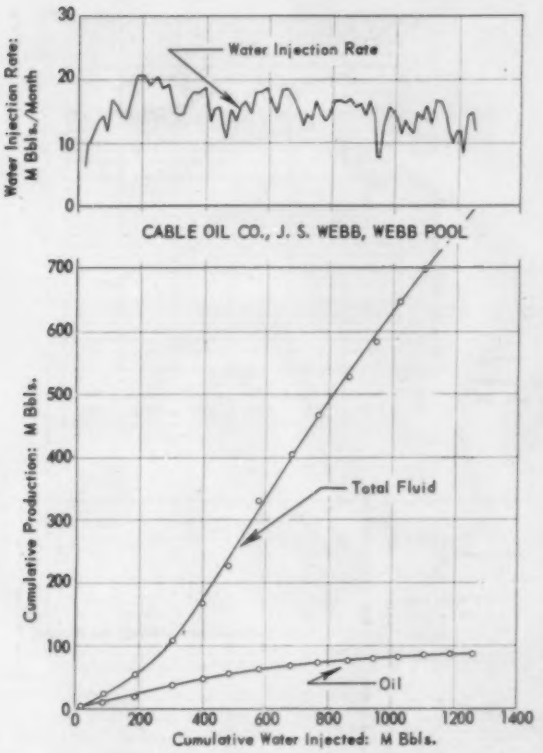
Water Injection Rate
Water Injection Rate: M Bbls./Month
CABLE OIL CO., J. S. WEBB, WEBB POOL
Total Fluid
Oil
Cumulative Production: M Bbls.
Cumulative Water Injected: M Bbls.

Fig. 1—Relation between fluid production and water injection for a North Texas water flood. (Data from BMRI 3906 and 4250).

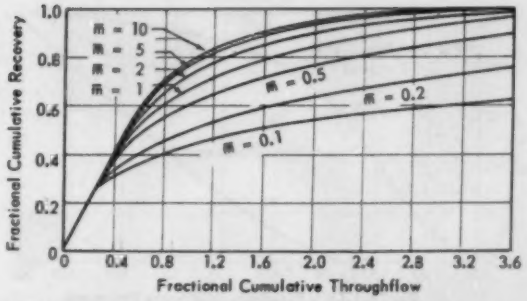

Fig. 2—Cumulative oil-recovery history vs. total fractional cumulative water and oil throughflow in exponentially stratified water-drive reservoirs for different values of the mobility ratio, $\bar{m}$ = (mobility of displaced oil)/(mobility of invading water). In all cases the stratification ratio = 20. (From data of Muskat, Trans. A.I.M.E. Vol. 189 [1950], p. 353).

the displacement may become irregular and ineffective.

In a summary of the basic physical elements involved in the mechanism of displacement of oil by water, Dr. George H. Fancher,[7] director of the Texas Petroleum Research Committee, emphasized the importance of capillary forces in the recovery of oil by water displacement, particularly in flooding heterogeneous rocks. He pointed out the interplay among capillarity, rate of advance of the flood front, and ultimate oil recovery:

"Capillary forces . . . would result in the effective displacement of oil from the less permeable portions of the rock to the more permeable before equilibrium can be achieved. . . . Consequently, if the rate of movement of water (the displacing medium) through the more permeable sand in response to viscous difference in pressure . . . is too great, oil cannot be displaced from the tighter portions of the sand until the flood front has passed by. Although equilibrium demands that oil be displaced from the less permeable sand, the oil accumulates in pores possessing a water saturation so great that it is lost to production because of lack of effective permeability to oil.

"Consequently, in secondary recovery by water flooding in heterogeneous sand or rock, the ultimate recovery of oil physically possible is proportional to the rate of advance of the flood front, and moreover, is greater the less the rate—and this virtually without limit."

Fluid mobility . . . When gravitational and capillary effects are negligible, the displacement pattern or shape of the flooding front, sweep efficiency, and the associated ultimate oil recovery from a water flood are dependent on the ratio of the mobilities of the displaced oil and the invading water. This behavior has been demonstrated by many investigators[5,8,9] for oil-water systems. Craig, Geffen, and Morse[10] studied a range of injection rates that simulated a wide variety of field flooding conditions when an initial free-gas saturation is also present. They observed no noticeable effect of rate upon oil recovery efficiency and concluded that fluid mobilities were controlling.

The effect of the mobility ratio on the performance of a water flood was described by Muskat[5] and is illustrated in Fig. 2. The recoveries shown in Fig. 2 for different values of the mobility ratio are for a formation having a particular distribution of permeabilities. Any variation in this permeability distribution would alter the shapes of the curves. If the displaced oil has a high viscosity, water breakthrough occurs early in the production history, and the fractional cumulative recovery prior to economic abandonment is low.

The purpose in presenting Fig. 2 is merely to show the influence of mobility on water-flood performance and to show the shape of the curves for cumulative oil recovery vs. cumulative water injected.

Evaluation of Water-Flood Performance

Several of the variables known to influence the behavior of a water flood were described in the previous section. Information that will permit a quantitative determination of the effects of these variables upon the performance of a flood has been difficult to obtain in the field in sufficient detail to provide precise analysis and interpretation of the process.

Data on the rates of injection and production are readily obtainable in the field and in many cases have been the only information available for an evaluation of the performance of an individual flood. Reviewed below are the methods of analyzing basic field data and several analyses of representative field water-flood projects. These analyses were undertaken to detect the influence of variations in rate upon the performance history and, more specifically, upon the ultimate recovery of oil from the flood.

Performance curves . . . The performance curve calculated by Hurst[11] for an idealized five-spot fluid displacement is shown in Fig. 3. In his analysis the reservoir was assumed to be homogeneous and the mobility ratio equal to unity. The similarity between Hurst's theoretical performance curve and those of actual flood histories can be seen by comparing Fig. 3 with Fig. 4, which shows the injection and production histories of six floods conducted in Nowata County, Oklahoma.[12] The many factors known to affect the behavior of floods account for the slight variations in the shapes of the cumulative oil

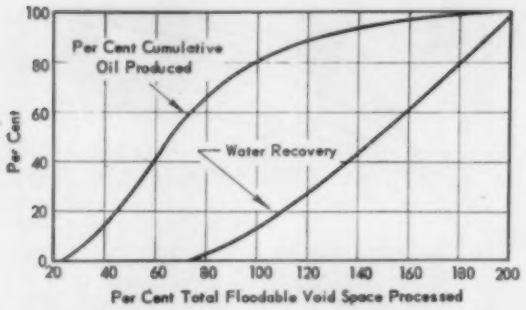

Fig. 3—Performance curve for five-spot water flood. (Data from Hurst, paper No. 127-G, October 1951, Petroleum Branch, A.I.M.E.).

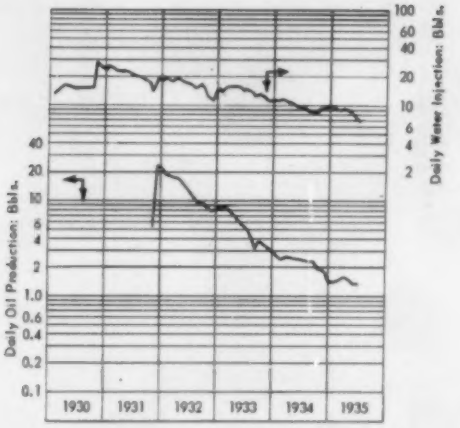

Fig. 5—Oil-production and water-injection history of flood No. 29, D-Unit, Bradford oil field.

curves. However, it is significant that in the individual performance curves there are no deviations in the slopes of the curves which can be related to fluctuations in the injection rates.

The historical practice in presenting production data for dissolved-gas reservoirs produced at capacity has been to plot the logarithm of the rate of oil production as a function of time. These production decline curves have been useful in predicting the performance of dissolved-gas-drive reservoirs. However, **this technique should not necessarily be expected to be applicable for the prediction of water-flood performance** because an entirely different recovery mechanism is involved and because the recovery process is subject to the control of the operator.

After a study of numerous floods in Bradford field, Pennsylvania, Yuster[13] concluded that:

"Since the over-all production curve on any property is made up of the individual production curves of various strata, the actual decline curve must not necessarily continue along the trend indicated in any range . . . "

"The second assumption, which involves a linear relationship between the log of the production against time, may hold for some properties which is felt must be special cases, but it cannot hold for all properties."

" . . . the semilogarithmic method of extrapolating is not mathematically exact for all cases and may not be used as evidence for losses during curtailment."

Plots of rates . . . The oil and water production and injection history for a typical water flood in Bradford field reported by C. R. Fettke[14] is shown in Fig. 5. No continuously linear relationship exists between the logarithm of the production rate and time, and any prediction based on a linear extrapolation using the early history of oil production is not valid.

If there is not net accumulation or

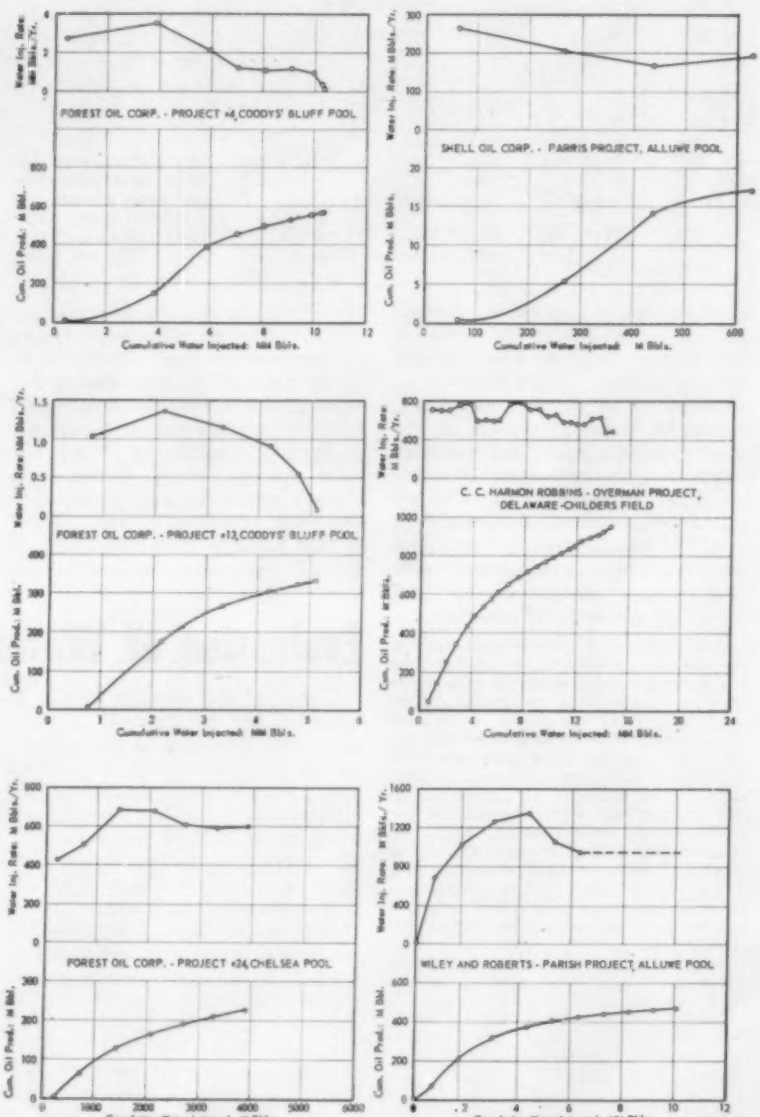
FOREST OIL CORP. - PROJECT #4, COODYS' BLUFF POOL
SHELL OIL CORP. - PARRIS PROJECT, ALLUWE POOL
FOREST OIL CORP. - PROJECT #12, COODYS' BLUFF POOL
C. C. HARMON ROBBINS - OVERMAN PROJECT, DELAWARE-CHILDERS FIELD
FOREST OIL CORP. - PROJECT #24, CHELSEA POOL
WILEY AND ROBERTS - PARISH PROJECT, ALLUWE POOL

Fig. 4—Relation between oil production and water injection for six floods in Nowata County, Oklahoma. (Data from BMRI 4831).

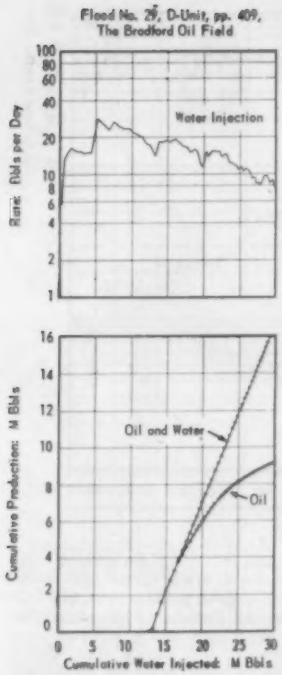

Fig. 6—Relation between fluid production and water injection—Bradford field floods. (Data from Bull. M-21, Penn. Geol. Survey, 4th Series [1928]).

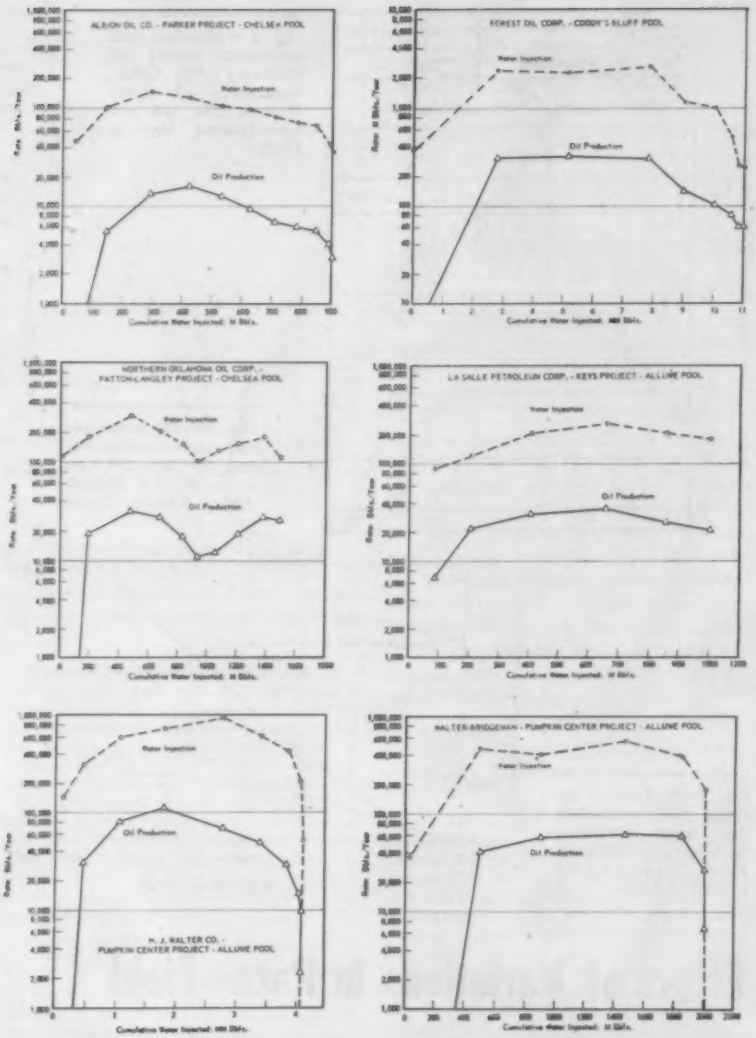
ALBION OIL CO. - PARKER PROJECT - CHELSEA POOL
FOREST OIL CORP. - COODY'S BLUFF POOL
NORTHERN OKLAHOMA OIL CORP. - PATTON-ANGLEY PROJECT - CHELSEA POOL
LA SALLE PETROLEUM CORP. - KEYS PROJECT - ALLUWE POOL
H. J. WALTER CO. - PUMPKIN CENTER PROJECT - ALLUWE POOL
WALTER-BRIDGEMAN - PUMPKIN CENTER PROJECT - ALLUWE POOL
Water Injection
Oil Production

Fig. 7—Relation between oil production and water injection for several water-flood projects in Oklahoma. (Data from BMRI 4831.)

depletion of the fluids within the unit (the condition usually existing after fillup in uniformly developed water floods), a plot of the cumulative oil and total fluid produced vs. the cumulative water injected into a complete water-flood unit is much revealing of the effectiveness of oil displacement by water.

The greater the slope of the oil curve, the more effective is the flood. If rate influences recovery of oil, any significant change in rate should result in a change in slopes of these curves.

Fig. 6 shows the relation between total fluid produtcion (oil and water) and water injected for Bradford field flood described above. After fillup, the cumulative oil produced continues to increase regularly with injection and shows no abnormal behavior even with a threefold change in injection rate during the life of the flood.

In a depleted oil reservoir that is being water flooded, there is a two-fluid system of relatively incompressible fluids over the range of pressures usually encountered; the small amount of residual gas present is produced or goes back into solution during fillup.[10,15] As each barrel of water is injected after fillup, fluid is produced into the well bore with no net accumulation of fluids in the reservoir.

Any change in this injection rate has an almost immediate effect on the oil production rate. Witness the injection and production history of six water floods in Oklahoma[12] illustrated in Fig. 7. In each case, changes in the oil production rate almost exactly follow changes in the injection rate for a major portion of the life of the flood.

After water breakthrough, the oil-production rate declines continuously unless the rate of injection of water is increased to compensate for the increased water production. This is illustrated by the flood performance of Sunray Oil Corp.'s Fankhauser Unit,[16] Greenwood County, Kansas, Fig. 8. Although the total fluid produced per increment of water injected remains constant as shown in Fig. 9, the oil rate declined after water breakthrough and the water-oil ratio increased. This behavior is not related to time as a variable but to the volume of water injected.

Another example is the history of Cable Oil Co.'s J. S. Webb[6] waterflood operation in Archer County, Texas, shown in Fig. 10. The oil-production rate declined early in the life of the flood as a result of early water breakthrough. The subsequent decline was not related to time, but, as can be seen in Fig. 1, the total fluid produced was directly proportional to the water injected.

The examples presented thus far are evidence that the production decline curve cannot be used indiscriminately to predict the performance of floods. The oil-production rate is not directly related to time but is strongly dependent upon the water-injection rate.

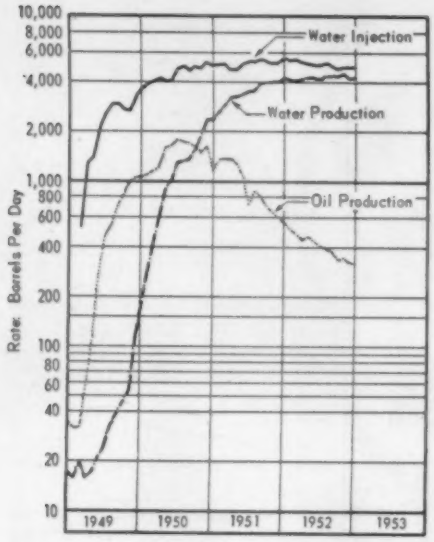

Fig. 8 — Injection and production history of Sunray Oil Corp., Fankhauser Unit. (After Walters, The Oil and Gas Journal, May 4, 1953).

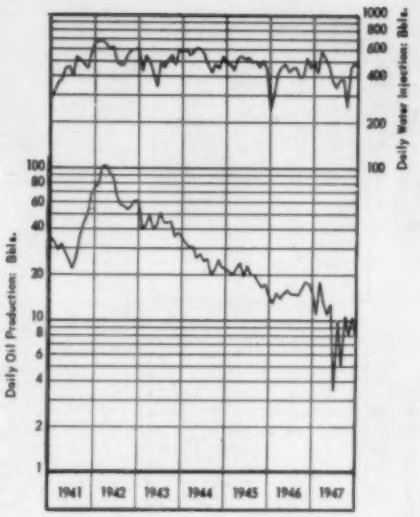

Fig. 10—Oil-production and water-injection history of Cable Oil Co.-J. S. Webb Project, Archer County, Texas.

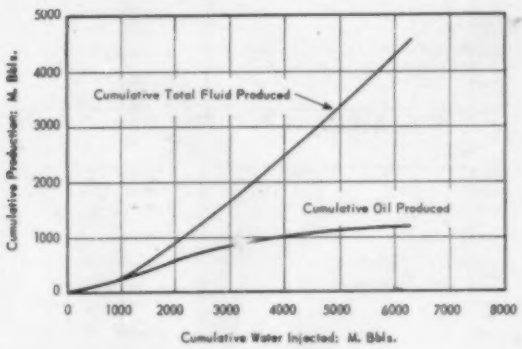

Fig. 9—Relation between fluid production and water injection—Sunray's Fankhauser flood, Greenwood County, Kansas.

Effect of Variations in Rate—Field

To provide a measure of the physical effectiveness of a water flood as a means of recovering oil, investigators have reviewed the performance of many water-flood projects. Their interpretation of the effect of variations in rate upon the ultimate oil recovery by water flooding are presented in the following discussion. Many of these authors have employed the terms "rate of water advance," "rate of injection," and "rate of production" as being interrelated in their consideration of the rate-recovery relationship.

After fillup is experienced in a water flood (at which time the greater portion of any free gas initially present in the rock has been produced or has been redissolved in the oil) the total fluid production rate becomes directly proportional to the injection rate. Under these conditions, the production of fluids can be controlled by either of two means: (1) the volume of injected water can be limited; or (2) the volume of produced water and oil may be controlled by maintaining back pressure at the producing wells.

Control of Injection Rate

Several authors have studied the effect of variations in the rate of water injection and the accompanying rate of water advance through the formation upon the flood performance and the ultimate oil recovery. Among them, Earlougher[17] published a paper in 1943 entitled "Relationship Between Velocity, Oil Saturation, and Flooding Efficiency." His investigation included both laboratory flooding tests on core samples and field data obtained from water floods in northeastern Oklahoma. Earlougher introduced the discussion of his laboratory data as follows:

"One of the most important results thus far indicated by these laboratory tests is the importance of velocity of water flowing through the sand and its relation to the oil-recovery efficiency and percentage of oil saturation at the time of the flood's inception . . . Many engineers have long held that slower velocities of water encroachment through a sand will yield the greatest ultimate oil recovery, while others still maintain that the highest possible velocities will yield by far the greatest oil recovery. The data upon which this article is based very strongly support the theory that slower velocities are in most cases far more efficient than higher ones . . .

"After data from the flooding of several hundred core samples had been assembled, curves of oil and water production vs. time were drawn up for many of them. The study of these curves soon revealed that, contrary to previous beliefs, the ultimate oil recovery was independent of the flooding pressure—samples were flooded at different pressures, varying from 5 to 50 psi. Some were flooded at constant pressure; for others pressures were increased during the run. Further inspection of the curves indicated that the most efficient oil recovery was obtained from the samples that yielded a low rate of flow, no matter whether the flooded pressure was 5 or 50 psi. . . ."

In presenting his interpretation of field data in this paper, Earlougher stated:

"After the results described above were obtained, numerous field records were studied in an attempt to substantiate the laboratory findings. The results were most gratifying, as shown by the accompanying illustrations . . .

"The property . . . also had an injection rate of about 7½ to 10 bbl. per day per acre, or 1.2 bbl. per foot per day. The oil production . . . came up to approximately 2.7 bbl. per day per acre and held at around 2 bbl. per day per acre for about 18 months. During the first 3 years the water-oil ratio was very favorable, but at the end of that time the operator boosted his injection rates. The results are quite evident. The cumulative water together with the water-oil ratio rose very sharply with little or no increase in oil production. In other words, the increased rate of water flow did little or no good . . ."

In conclusion, he pointed out:

"1. For any given oil saturation there is a critical maximum velocity above which the recovery efficiency falls off rapidly.

"2. When this critical velocity is exceeded, the water-oil ratio rises extremely fast and thus shortens the economic life of the flood, and in turn reduces the ultimate oil recovery."

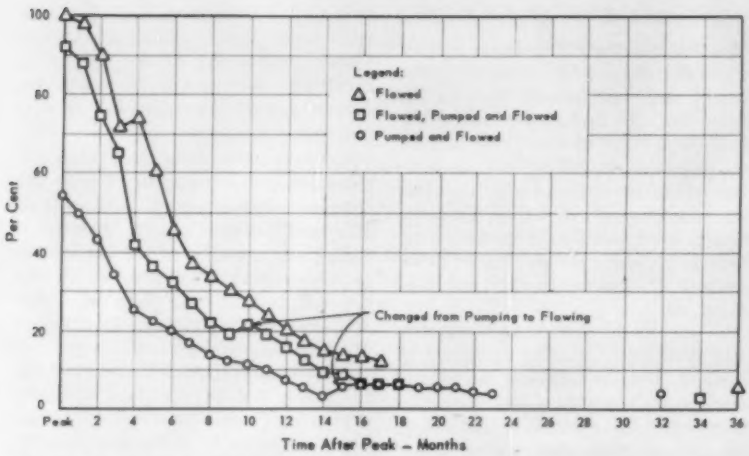

Fig. 11—Production-decline curves based on peak of Δ at 100 per cent. (From Lawry, A.P.I., May 20-21, 1943.)

More recent comments on the water injection rate were given by Earlougher and Amstutz[18] in a paper presented before the secondary-recovery symposium held in Wichita Falls, Tex., in November 1954. They indicated from their observation of numerous floods that there is a limiting range within which the rate of water injection should be maintained for satisfactory flood operations. The authors stated that during the initial, or fillup, period of injection, a unit rate of between 1 and 2 bbl. per day per acre-foot is desirable. After fillup has been achieved, the injection rate should be maintained at about 1 bbl. per day per acre-foot and at not less than ½ bbl. per day per acre-foot.

Control of Production Rate by Back Pressuring

To maintain back pressure at the producing well, production of fluids at the surface is curtailed with the result that pressure in the well bore increases to the point where water-flood production can be obtained by flowing rather than by pumping. Therefore, control of production rate by back pressuring and production by flowing implies a restriction in the rate from capacity production by pumping.

In the following section are discussed several floods whose rates of production were controlled by back pressuring. The effects of restriction of rate under flowing operations on the performance of the floods and on the ultimate oil recovery are compared with the recoveries to be anticipated at higher rates under pumping operations.

Under enforced curtailment of water-flood production from the Bradford-Allegany fields during early 1930 to adjust production to demand, several operators employed back pressure and flowing methods as a means of continuing their floods under restricted rates. Later that year, Torrey[19] reported:

"The system of back pressure and flowing has been used with great success on several properties . . . A most desirable reduction in operating costs is effected by the use of this method since pumping is not required and in addition it tends to conserve the available supply of gas.

"... The use of this method will unquestionably force a more uniform flooding action throughout the sand body which combined with the apparent economies of operation which it affords makes it the most desirable method known to the writer for controlling oil production."

In a later Bradford district research study of this curtailment, Yuster[13] concluded that no appreciable quantities of oil were lost by curtailment of production, but that the production was only deferred. He further observed that the water-oil ratios did not depart from normal behavior because of shutdowns or curtailment.

Merits of flowing . . . With the development of water flooding in the shallow Mid-Continent fields, production of water-flood oil by flowing rather than by pumping appeared to many operators to possess definite advantages in simplicity of operation and in economy of first cost and operation. One of the foremost proponents of flowing production was Lawry,[20] who reported in 1943 the results of his experience with flowing methods and drew certain conclusions regarding the effect of restriction in rate of production under flowing operations on ultimate oil recovery.

Lawry emphasized the advantages of flowing methods over pumping and indicated that as great a quantity of oil was obtained by flowing as would have been produced under conventional pumping operations. He presented (see Fig. 11) production data from three 40-acre floods showing the typical decline during pumping operations and the resultant change in production for two of the floods upon their conversion from pumping to flowing. Under flowing conditions, there is a distinct upward displacement of the decline curve followed by a more gradual flattening of the curve than obtained during pumping.

In 1946, Earlougher[21] compared the relative merits of flowing vs. pumping methods of production in secondary water floods conducted on three contiguous leases in Nowata County, Oklahoma. In the center area production was obtained by flowing, whereas for the two outside floods pumping was employed. He showed that the production-decline rate for the flowing flood was more gradual than for the pumping flood and that the estimated ultimate recoveries were quite comparable. He concluded that flowing should not result in a loss of oil recovery but could be expected to give as great an ultimate recovery as pumping.

Concerning the choice between flowing or pumping as a producing technique, Taliaferro[22] said:

"If the produced fluids are not pumped to the surface, the pressure at the bottom of the producing wells will gradually build up until the wells will flow. The cost of pumping is, of course, a major expense, and it is a saving well worth while if it can be eliminated without adversely affecting the ultimate recovery from the property. Opinions differ on this point, however, and it is another question that is difficult to settle because of the inability to produce a property by one method and then repeat the operation using a second method. The practice of flowing water-flood production is becoming more widely used. Some proponents of this method contend that it will result in greater ultimate recovery."

In the A.P.I. volume, Secondary Recovery of Oil in the United States, Lawry[23] concluded that there is no difference in the ultimate recovery of water flooding whether by flowing or by pumping under comparable conditions. He illustrated his article with Fig. 12 as a typical case history of many water floods which were converted from pumping to flowing after the economic life by pumping had been reached. He pointed out that:

"...30 bbl. per day was the economic limit for pumping . . . In the 48 months since the lease . . . was converted from uneconomical pumping to profitable flowing, it has recovered for its owners an additional several hundred barrels of oil per acre that would otherwise have been lost in premature abandonment of the pumping project."

The advantages of flowing over pumping production were presented in 1950 by Joers, Grandone, and Taliaferro[24] in a Bureau of Mines study

of "Water Flooding in the Humboldt-Chanute Oil Field, Neosho and Allen Counties, Kansas." Referring to the Lynde, Walter, and Darby flood, they stated:

"Originally all the producing wells were equipped to be pumped. However, during 1942 and 1943, the flowing of production from wells on the Kaney lease was tried and found successful. Accordingly, from 1944 to 1946, all producing wells in the project were converted to flowing. All new wells completed since 1945 were equipped to flow from the beginning. The operator reports that individual lease records show a 30 to 40 per cent decrease in the rate of oil production immediately after conversion from pumping to flowing. However, after approximately a year, the production rate was back to the extrapolated pumping-production rate, and a year and a half later the lost production had been regained . . . A greater ultimate recovery from the properties by flowing is indicated because the reduced operating cost will result in a much longer economic life."

In a "Panel Discussion of Kansas-Oklahoma Secondary Recovery Problems" in December 1948, Earlougher[25] answered the question, "Is the practice of controlling or restricting the production from wells in a flowing flood effective in increasing the recovery of the flood?" as follows:

"The question is still controversial and must be solved for each individual property on its own merits. Results of some floods indicate that flowing wells intermittently result in increased oil production with lower water-oil ratios."

Flowing wells intermittently constitutes deliberate curtailment of production to less than capacity rates.

In summary, curtailment through control of production rate by flowing rather than pumping did not result in a decrease in ultimate oil recovery from water-flood properties. Instead, important economic advantages accrued to back pressuring, inasmuch as flowing production was obtained and operations could be continued to a much lower daily production than was possible were pumping required.

Control of Oil Migration

One of the most important aspects of a water flood to its operator is the control that will permit him to recover the oil underlying his flood area. Distortion of the flood pattern and migration of oil beyond the confines of the flood area must be avoided. Migration of oil across property lines can be avoided or equalized by careful control of the relative volumes of injected water and produced oil.

It has long been recognized that control of production is necessary to promote effective recovery and to prevent physical waste. Conservation is based upon the exercise of control of the rate of production during either a primary or a secondary recovery program.

The objectives of conservation are realized within a given pool through a method of allocation of production which prevents physical waste and at the same time protects the correlative rights of the various operators and royalty owners. The proportionate share of the total state market demand to be produced by a single pool must be distributed equitably to prevent reasonably avoidable drainage of oil and gas across property lines.

This system of conservation and allocation of production to accomplish these objectives has been generally accepted as reasonable and fair in the production of oil under natural-recovery mechanisms. Secondary water-flooding operations are no different basically, and the same controls may be exercised to assure equitable withdrawals and protection of the property rights of owners.

Cooperative effort . . . The difficulties arising from regional migration of oil during secondary water-flood operations may be minimized or removed through cooperative effort among the producers. If the operator is a participant in a unitized project, the problem of migration is eliminated through proper engineering of the project to distribute the production equitably and to protect the rights of all participants.

If the flood is an isolated operation surrounded by producing areas not subjected to secondary water flooding, the operator cannot, of course, anticipate recovery of all of the oil on his property that may be outside his well network. In fact, his flood will most probably have a beneficial effect on neighboring wells.

To insure efficient recovery from his flood, the operator must maintain comparable conditions at his producing wells to those of his neighbors. If he maintains this balance, there will be no more migration from his flood area at either high or low injection rates. Since the production rate is directly related to the injection rate, unlimited withdrawals are not necessary to maintain this flood balance.

Another possible condition is that several contiguous floods are operated independently. If conditions at all producing wells are comparable and one operator injects at a higher rate than his neighbors, there will probably be a distortion of his flood pattern that will result in an ultimate decrease in recovery from his segment of the reservoir.

Unlimited withdrawals from the producing wells are not necessary to prevent migration of oil and water beyond the flood area. Maintenance of low pressure at the producing wells should not be confused with high production rates. It is also possible to maintain a low pressure at the producing well at reduced rates of production by reducing the rates of injection proportionately since the rate of production can be controlled by the rate of injection. It is the ratio of injection rate to producing rate rather than the absolute rate of either that is

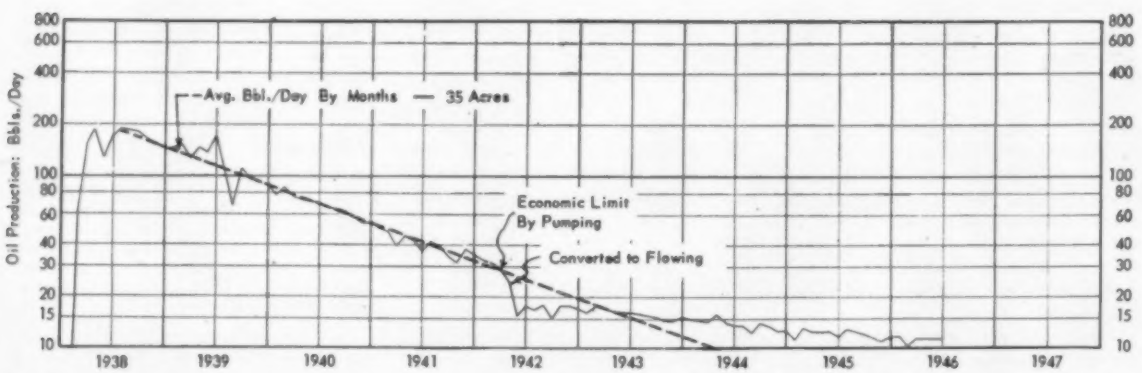

Fig. 12—Typical water-flood decline curve, showing long depletion period possible by flowing. (Source: Lawry, Sec. Rec. in U. S., A.P.I., 1950.)

important in preventing distortion of the flood pattern.

Conclusion from Field Evidence

The examples of field experience with water flooding presented in the foregoing discussion are representative of a thorough, critical review of the literature and are indicative of the success of flooding operations under controlled rates. Fundamentally, the mechanism of displacement of oil by water from the porous rock by secondary water flooding is identical with that occurring during the natural water-drive process. Many factors such as the degree of uniformity of formation permeability, relative permeability-saturation relation, capillary forces, and ratio of fluid mobilities influence the recovery of oil by water displacement.

Analyses of the performance of the water floods cited here lead us to conclude that high injection rates with unrestricted or capacity production are not necessary to obtain maximum recovery. Further, we conclude that over the range of rates normally encountered in the field the ultimate oil recovery from secondary water floods is not adversely affected by restriction of rate. Curtailment of the rate of production will not reduce ultimate recovery; in fact, in heterogeneous sands containing intercommunicating lenses or strata where capillary effects may be significant, reduction in rate of flood advance will most probably enhance oil recovery.

However, despite the preponderance of technical evidence to the contrary, certain field behavior continues to be interpreted by some to show a deleterious effect resulting from any curtailment of production or injection. Muskat[26] summarizes the situation quite well in Physical Principles of Oil Production:

> "While the reported discrepancies possibly may be due to differences in the nature of the formations and fluids involved, it is not clear, from a physical point of view, why a significant effect of the velocity on the recovery should be expected, unless the order of magnitude of the gradients is equivalent to the threshold pressure for displacing such segregated oil masses as may be trapped in localized parts of the rock."

Lack of understanding . . . When the difficulty of obtaining adequate field data on a secondary water flood is realized, it is not surprising to find some field evidence being interpreted to indicate an effect of rate on oil recovery. Many factors such as variability of formation characteristics, uncertainty as to initial oil content within the formation, interference between wells and between areas being flooded, etc., limit the accuracy and pertinence of field data.

There also appears still to be a serious lack of understanding in some quarters concerning the principles governing the interpretation of field data in such operations. All these conditions hamper the utilization of field information to predict the behavior and recovery in secondary water-flood operations.

Because of this confusion in the minds of some concerning the interpretation of field data, many reservoir engineers and research scientists have turned to the laboratory for assistance in resolving the problem. There, controlled experiments, free from the many unknown and uncontrollable factors inherent in field and pilot tests, give results that can more adequately describe the physical process and can assure a more complete interpretation. The succeeding section of this report presents results of many such experimental and theoretical investigations.

Effect of Variations in Rate—Laboratory

Before describing laboratory research which is pertinent to the effect of rate of water advance on recovery, it may be helpful to consider the velocity distribution that exists between an injection and a producing well. Such a velocity distribution for several injection rates has been calculated based on the data from Hurst's paper[11] on the performance of a five-spot water flood. These calculations are summarized in Tables 1 and 2 for 10 and 20-acre well spacings, respectively.

Flood velocities . . . At an injection rate of 1 bbl. per foot per day for a 10-acre spacing for a formation with 20 per cent porosity, the minimum velocity of water advance directly between the injection and production wells is slightly less than 0.02 ft. per day. If the injection program were designed for the injection of one pore volume in 10 years, the injection rate would be 4.25 bbl. per foot per day and the minimum velocity between injection and production wells would be 0.085 ft. per day.

In the flooding of a formation having 25 per cent porosity with 35 per cent connate water, 50 per cent initial oil saturation, and 15 per cent initial gas saturation, Hurst showed that about 98 per cent of the total recoverable oil (based on a residual oil saturation of 20 per cent in the portions swept by water) would be produced if the injection were continued until the produced water-oil ratio reached 7.5 to 1.0 (88 per cent water). This necessitated the injection of 0.725 pore volume of water. If it is desired to complete this injection program for 10-acre spacing in 10 years, an injection rate of 3.84 bbl. per foot per day would be required, and the corresponding minimum velocity would be 0.077 ft. per day.

The minimal velocities between injection and production wells for comparable programs with 20-acre spacing were lower by a factor equal to the reciprocal of the square root of 2.

Figs. 13 and 14 are isovelocity maps showing the distributions of the velocity of water advance (in terms of feet per day per barrel injected per day per foot of formation) within the injection patterns described above. Fig. 15 presents the steady-state fluid velocity profile between the injection and

TABLE 1—WATER VELOCITY FOR 10-ACRE SPACING

(Tabulated numbers are values for the indicated contours in Fig. 13, and give the rate of advance of the water, ft./day)

	Injection Program		
Fig. 13 contour:	Condition 1*	Condition 2†	Condition 3‡
0.01	0.01	0.0425	0.0386
0.02	0.02	0.085	0.077
0.03	0.03	0.128	0.116
0.04	0.04	0.170	0.154
0.05	0.05	0.210	0.193

*1 bbl./ft./day for flow through 20 per cent porosity. †1 pore volume in 10 years, 20 per cent porosity, 4.25 bbl./ft./day. ‡10-year flood of 25 per cent porosity sand, 3.84 bbl./ft./day. Initial conditions: 35 per cent connate water; 50 per cent oil saturation; 15 per cent gas saturation. Conditions at end of flood: 20 per cent oil saturation and 80 per cent water saturation in flooded area.

TABLE 2—WATER VELOCITY FOR 20-ACRE SPACING

(Tabulated numbers are values for the indicated contours in Fig. 14, and give the rate of advance of the water, ft./day)

	Injection Program		
Fig. 14 contour:	Condition 1*	Condition 2†	Condition 3‡
0.007	0.007	0.06	0.055
0.014	0.014	0.12	0.11
0.021	0.021	0.18	0.16
0.028	0.028	0.24	0.22
0.035	0.035	0.30	0.28

*1 bbl./ft./day for flow through 20 per cent porosity. †1 por volume in 10 years, 20 per cent porosity, 8.5 bbl./ft./day. ‡10-year flood of 25 per cent porosity sand, 7.67 bbl./ft./day. Saturations at start of flood: 35 per cent connate water; 50 per cent oil; 15 per cent gas. Conditions at end of period: 20 per cent oil saturation; 80 per cent water saturation in flood area. Water-oil ratio: 7.5. Oil recovery, 97.6 per cent of ultimate.

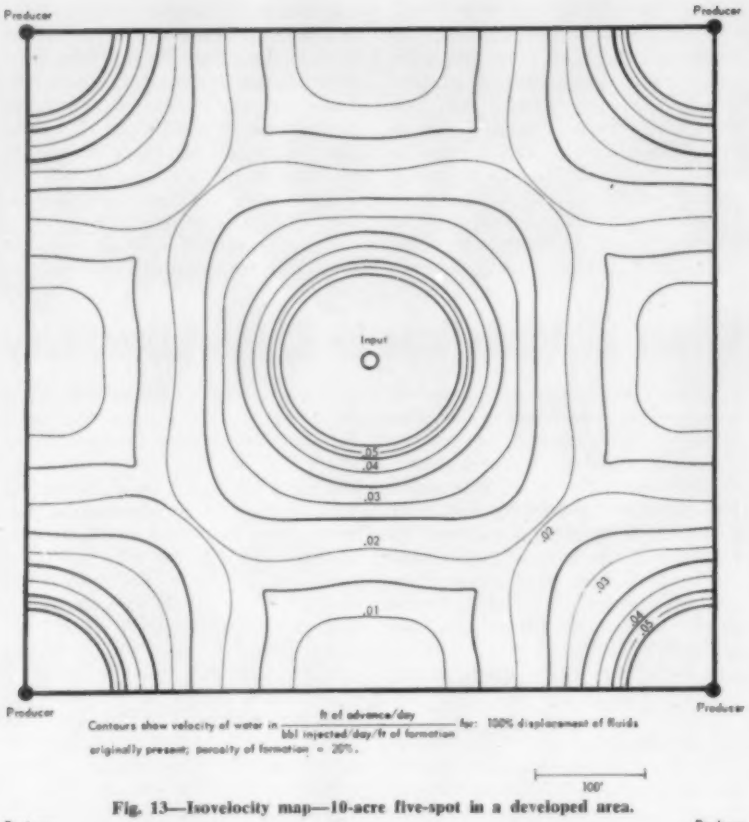

Fig. 13—Isovelocity map—10-acre five-spot in a developed area.

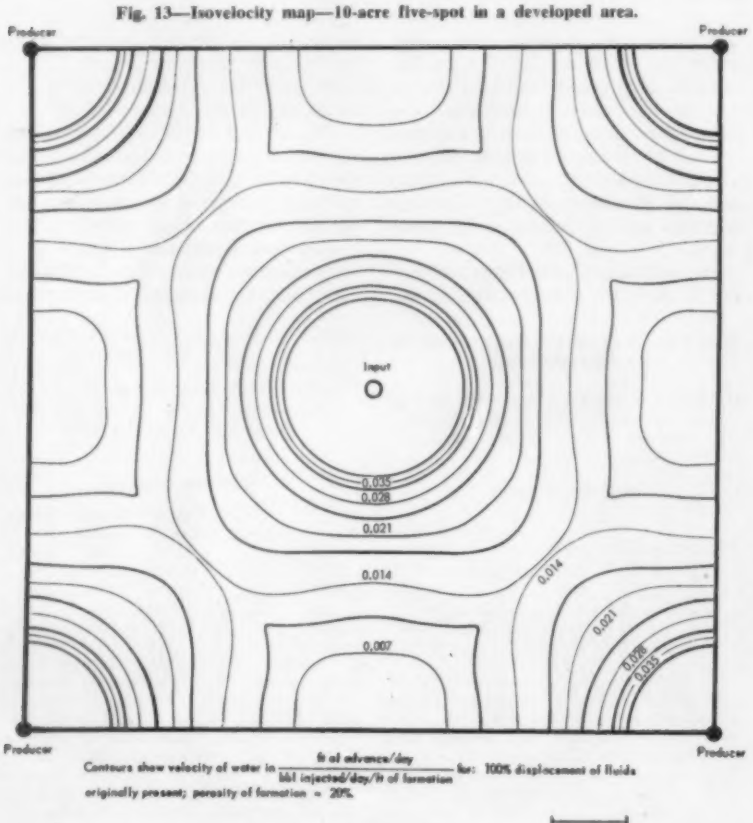

Fig. 14—Isovelocity map—20-acre five-spot in a developed area.

producing wells for the 10 and 20-acre five-spots. Also shown on this graph is the velocity pattern surrounding a single well during radial steady-state flow. The pattern curves are reversed at the minimum velocities which occur midway between the injection and producing wells.

Although these data and maps are for homogeneous reservoir and for homogeneous fluids flowing in a steady state, the velocities shown are of the correct order of magnitude for real floods. In reservoirs producing efficiently under natural water drive, rates of water advance generally are in the range of 0.5-1.0 ft. per day.

Laboratory scaling . . . Another factor that should be considered before laboratory research is reviewed is the scaling of experiments to simulate the flooding of real reservoirs. The criterion of successful scaling is that the flowing water-oil ratio at any point in the laboratory model be the same as at the corresponding location in the reservoir after proportionate volumes of water have been injected.

To fulfill this requirement, it is necessary for the following to be identical in the model and in the reservoir: the ratios of the magnitudes of the applied, capillary, and gravitational pressure gradients; the ratio of the fluid viscosities; the dependence of relative permeability and capillary pressure upon fluid saturation; the initial distribution of water and oil; and the geometrical configuration.

When the size of a flow system is reduced so that it can be handled in the laboratory, the flow rate must be increased correspondingly since it is inconvenient to reduce the capillary and gravitational pressure gradients sufficiently to maintain the proper ratios required for scaling. If the above conditions are fulfilled, the flooding behavior of the laboratory model can be directly interpreted in terms of the actual reservoir, and it is possible to study quantitatively the effect of rate on recovery.

Homogeneous Water-Wet Sands

Although reservoirs with uniform sands are never found, much insight into the fundamental behavior of fluids and into the basic mechanism of displacement has been gained from work on homogeneous sands.

Effect of Rate During Initial Displacement

During the displacement of the oil, the water advancing through the different-sized pores causes certain of the continuous oil filaments to become broken. All of the filaments which connect particular groups of oil-filled

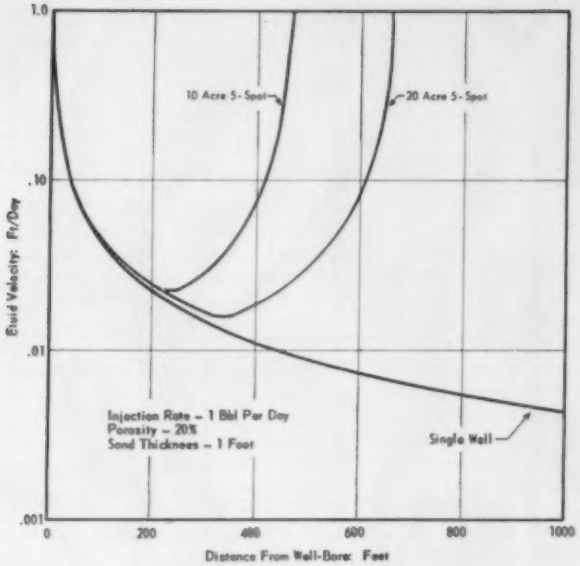

Fig. 15—Rate of fluid advance.

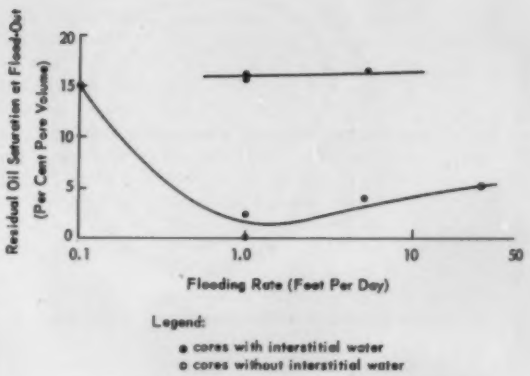

Fig. 17—Reproduction of "Fig. A" from Leach, Geffen, and Berry.[33]

pores with the remainder of the oil are destroyed, and the oil contained in these groups of pores is isolated, held immobile by the surrounding water, and quite effectively trapped as residual oil. Fig. 16 is a photomicrograph of a metal cast of a typical residual oil globule.

The particular paths through the rock that the advancing water interfaces take and the sequence in which individual pore chambers are flooded are not accidental. They are determined by the pressure that forces water into each chamber and by the resistance to flow encountered in the process. In normal flooding operations, the pressure controlling the entry of water into particular pore chambers is the capillary pressure; an increase in the injection pressure in the range of practical interest cannot alter the sequence of the microscopic displacement.

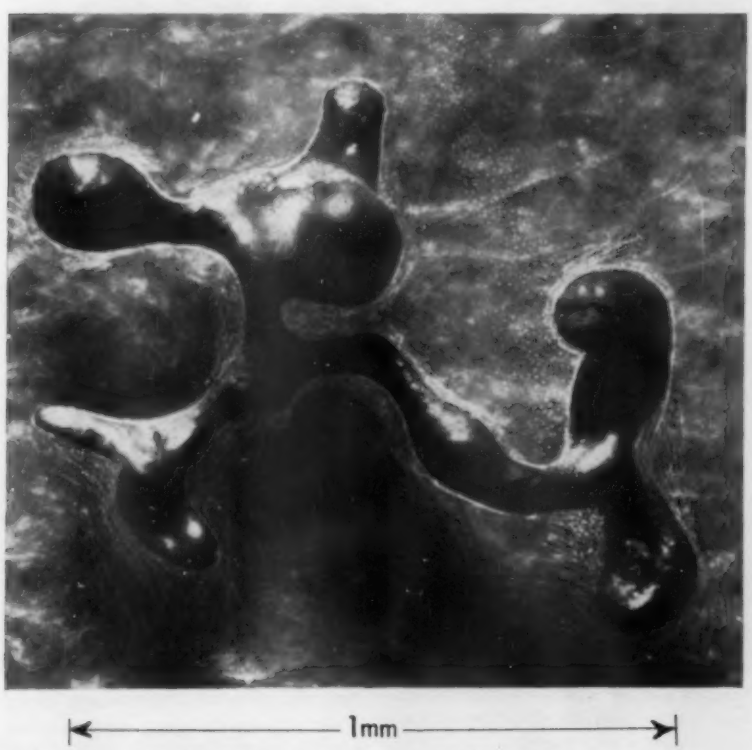

Fig. 16—Typical residual oil globule (57-70-mesh sand).

This control by capillary pressure results from the fact that, although the capillary pressure difference forcing the water into the pore may be only a few tenths of a psi., it acts over a distance of only a few hundredths or thousandths of an inch, and, therefore, produces a pressure gradient acting on the water in the order of hundreds of psi. per inch. This localized pressure gradient is approximately a **thousand times larger** than that resulting from injection of the water at usual rates.

Thus, the sequence in which the pore chambers are flooded and the locations and numbers of "traps" in which the oil filaments become broken into discontinuous globules are determined solely by the capillary pressure, which, in turn, is determined by the wettability and the pore geometry of a particular rock. By a microscopic study of the flooding process, Kimbler and Caudle[27] verified this concept.

Therefore, the residual oil content of the rock, i.e., the amount of oil which is trapped and held immobile as discontinuous globules, is not dependent on the rates of injection normally employed in the field. Moore and Slobod[28] designed experiments to determine the rates of injection necessary to effect a decrease in the residual oil saturation of water-wet sands; they concluded:

> "Recovery is practically independent of rate of flooding from reservoir rates up to 40 ft. per day.
>
> "At extremely high rates (over 100 ft. per day) significant recovery increases were observed."

To obtain an average rate of advance of 40 ft. per day in a 20-acre

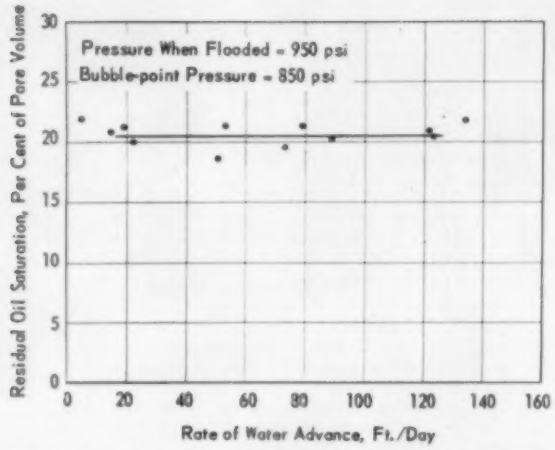
Pressure When Flooded = 950 psi
Bubble-point Pressure = 850 psi
Residual Oil Saturation, Per Cent of Pore Volume
Rate of Water Advance, Ft./Day

Fig. 18—Effect of rate of water flooding on residual oil content when flooding at a pressure in excess of bubble point with no free gas present (homogeneous sand).

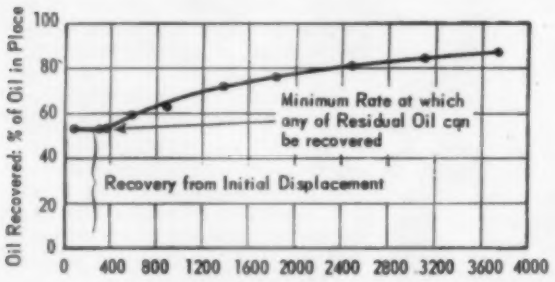
Minimum Rate at which any of Residual Oil can be recovered
Recovery from Initial Displacement
Oil Recovered: % of Oil in Place
Pressure Gradient: psi/ft.

Fig. 19—Pressure gradient required to recover the discontinuous residual oil.

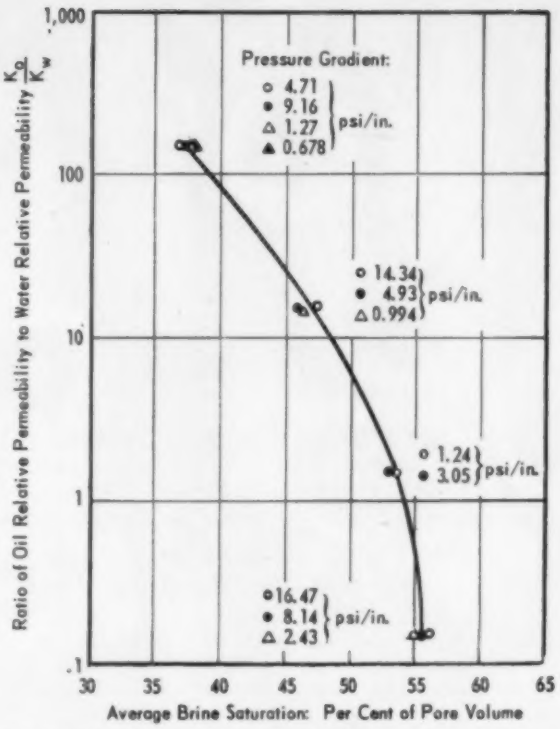

Fig. 20—Relative permeability as a function of brine saturation: measurements at different pressure gradients (from data of Geffen, Owens, Parish, and Morse[34]).

five-spot would require the injection of about 1,400 bbl. per day for each foot of sand thickness of the reservoir. This is approximately 100 times higher than the rate of injection in most field operations.

Other core tests . . . The results of laboratory core tests pertaining to the dependence of residual oil on rate were reported by several authors prior to 1950. However, in many of these early tests, the dependence of residual oil on other factors, such as boundary effect, hysteresis, and wettability, was not recognized, and changes of residual oil content were erroneously attributed to changes in pressure gradient. In 1951, Calhoun and Larue[29] reported laboratory results which indicate that residual oil saturation is independent of the velocity of the flood.

In 1952, Freeland and Calhoun[30] reviewed published reports of laboratory tests of oil recovery and concluded that there is "no apparent effect of pressure gradient on oil residuals." Many previous authors had overlooked the importance of the initial conditions of oil and water saturation; Freeland and Calhoun said that in the reports they reviewed, the residual oil saturations following displacement ". . . are controlled to such a degree by initial saturants that any pressure gradient effects are masked."

In 1955, concurrently with the Moore and Slobod presentation regarding the effect of rate described above, Newcombe, McGhee, and Rzaza[31] reported that in water-wet systems ". . . the rate of water injection has an appreciable effect on oil recovery." Newcombe et al. did not perform their experiments in sands containing connate water but in sand columns initially 100 per cent saturated with oil. In the absence of an initial connate-water saturation it is not believed that wetting equilibrium was attained during the displacement of oil by water. So the conclusions of Newcombe et al. cannot be accepted as characteristic of water-wet sands. In public discussion of the paper of Newcombe et al., Leach, Geffen, and Berry[32] commented that they had performed similar laboratory experiments with and without the presence of connate water. They stated:

"When interstitial water was present, the solid surfaces were mostly covered with water prior to injecting the flooding phase. Consequently, a condition very near wetting equilibrium existed throughout the flood. The data in Fig. A* show that under these circumstances, rate had no influence on residual oil at floodout, over the range of rates studied.

"On the other hand, in the absence of interstitial water, the surfaces are all covered with oil prior to injecting the wetting phase. To achieve wetting equilibrium the injected water must displace the oil from the surfaces themselves. This is not a fast process. Therefore, the effective dynamic wetting condition in floods of this type must depend upon the flooding rate. . . .

"We believe that, in the absence of an interstitial water saturation, oil recovery varies with rate because of the reasonably slow approach to wetting equilibrium which occurs during the displacement. . . ."

Experiments performed in Humble's laboratories have also demonstrated that in the presence of interstitial water the residual oil attained by a water flood is independent of the rate of flooding. In each of 12 experiments (see Fig. 18), a kerosine-methane mixture with an 850-psi. bubble point was displaced by water at a pressure of about 950 psi. from a sand-packed tube containing about 10 per cent interstitial water. The displacements were conducted at rates of 3 to 134 ft. per day. Although it may appear that the rates of displacement were

*A copy of the graph referred to by Leach et al., as "Fig. A," is shown as Fig. 17 of this report.

far in excess of those of interest in field floods, it will be shown in a later portion of this review that such rates are necessary to scale laboratory experiments to the rates and distances representative of field dimensions.

Effect of Rate on Trapped Oil

Because a pressure gradient of hundreds of psi. per foot is required to force an isolated oil globule through the surrounding water-filled tunnels, oil is quite effectively trapped after it has become discontinuous. The results of an experiment conducted to determine the pressure gradient required to mobilize the trapped oil are shown in Fig. 19.

A Berea sandstone core was saturated with brine and then flooded with oil until the water saturation was reduced to 29 per cent of the total pore volume. It was then flooded with brine until no more oil was produced. The injection pressure was increased incrementally and the quantity of oil produced at each step recorded. None of the residual oil could be recovered until a pressure gradient of 370 psi. per foot was attained. At this pressure gradient, water flowed through the core at a rate of 350 ft. per day.

Therefore, any change in the rate of flooding which can be produced in actual field operations will be completely ineffective in releasing trapped oil. The ineffectiveness of an increase in rate in the field under those conditions has also been discussed by Fancher.[33]

Effect of Rate on Oil Recovery Prior to Attainment of a Specified Water-Oil Ratio

The previous discussion was limited to the effect of rate of water advance on the total quantity of oil that can be displaced from the pores of a rock by water flooding. No consideration was given to the quantity of water required to displace this oil or to the ratios of oil and water production in the final stages of the displacement.

In practice, however, there is usually a limiting economic water-oil ratio which dictates abandonment. The "ultimate recovery" from a field, i.e., the oil recovered prior to abandonment, may be less than that total which could be recovered if the water flooding were continued indefinitely. The limiting water-oil ratio depends on the market value of the oil and the cost of handling and disposing of the water; thus, it may differ among various fields at a given time and at different times in the same field.

From an operational standpoint, it is important to know whether or not a change in rate of water advance will affect the quantity of oil which can be recovered prior to attainment of any specific water-oil ratio. To answer this question it is necessary to determine what physical factors control the relative rates of flow of oil and water through the rock and then to consider how these factors are influenced by a change in the rate at which water is injected.

Investigators in various research laboratories during the last 25 years have formulated and verified experimentally quantitative relationships which express the dependence of the relative rates of flow of oil and water upon the pressure gradients and upon the characteristics of the rock and its fluids. From such research it is possible to design and conduct properly scaled experiments to reveal the influence of rate on oil recovery.

The factors which determine the relative rates of flow of water and oil at any point are the relative pressure gradients and the relative resistances to flow of water and oil; the latter factors are conveniently described in terms of the relative permeability of a rock to each of the fluids flowing and of the respective viscosity of each fluid.

Relative permeability . . . Early students of reservoir fluid mechanics were not in agreement on the dependence of relative permeability on rate of flow. However, intensive research in 1947-1952 culminated in a series of papers[33 34 35 36 37 38] which pointed out that the apparent rate sensitivity of relative permeability reported by some earlier authors was probably a manifestation of the "boundary or end effect" which is significant in small cores but negligible in reservoirs.

In some instances the reported sensitivity of relative permeability to rate was probably due to the effects of fluid saturation hysteresis or of changes in wettability. In 1951, Geffen, Owens, Parrish, and Morse[36] presented experimental data (Fig. 20) which indicated no change in relative permeability to oil and to water accompanying a change in rate of flow in the range of rates of practical interest. Papers by Osoba, Richardson, Kerver, Hafford, and Blair[37 38] reported that relative permeability is also independent of the rate of flow in gas-oil systems.

Pressure gradients . . . Pressure gradient, the other factor controlling relative rates of flow of oil and water, consists of the following components: the applied pressure gradient required to force water through the rock at the desired rate; that resulting from the force of gravity acting on two fluids of different densities; and that due to differences in capillary pressures resulting from differences in fluid saturations in adjacent parts of the rock. The applied pressure gradient is in a direction to cause fluids to flow outward from the injection well. The gravity component acts to cause the heavier water phase to flow downward under the oil. The capillary pressure component in a homogeneous sand causes water to move from regions of higher water saturation to regions of lower saturation.

Negligible capillary and gravitational forces . . . The relative rate and direction of flow of water and oil at any point in the rock are determined by the product of the ratios of effective water permeability to effective oil permeability, oil viscosity to water viscosity, and pressure gradient in water to that in oil.

When capillary and gravitational forces are negligible, the pressure gradients in the water and in the oil are identical and, therefore, the water-oil ratio is determined only by the ratios of the relative permeabilities and the viscosities. Since relative permeabilities and viscosities are independent of rate, the water-oil ratio at any point is independent of rate. Hence, the amount of oil recovered prior to any specified water-oil ratio is independent of rate and therefore the recovery of oil is not adversely affected by a reduction in rate.

That recovery can be predicted from appropriate relative permeabilities and fluid viscosities is graphically illustrated in Fig. 21. Oil recoveries were calculated at various produced water-oil ratios for oil-water viscosity ratios of 1.4 and 119 according to the method of Buckley and Leverett[39] using a typical imbibition relative-permeability curve. Experimental data (shown in Fig. 21 as circles) are in excellent agreement with these calculated values.

In Fig. 22 the data for these two experiments are plotted to show oil recovery as a function of the quantity of water injected. These data demonstrate that in a homogeneous water-wet reservoir in which capillary and gravitational forces are negligible, the recovery is a predictable function of the quantity of water injected. An increase in the injection rate will shorten the time required to complete the displacement but will not affect the quantity of oil recovered prior to attainment of any specified water-oil ratio.

When capillary and gravitational forces are important . . . It has been demonstrated that the recovery of oil

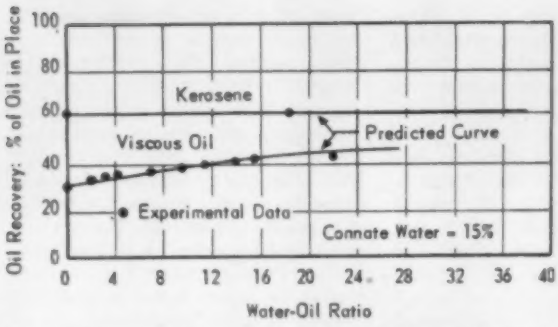

Fig. 21—Amount of oil recovered prior to attainment of various water-oil ratios—comparison of predicted and observed recoveries.

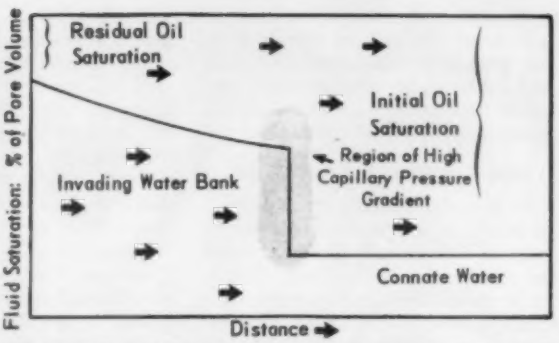

Fig. 23—Schematic saturation profile illustrating the displacement of oil by water.

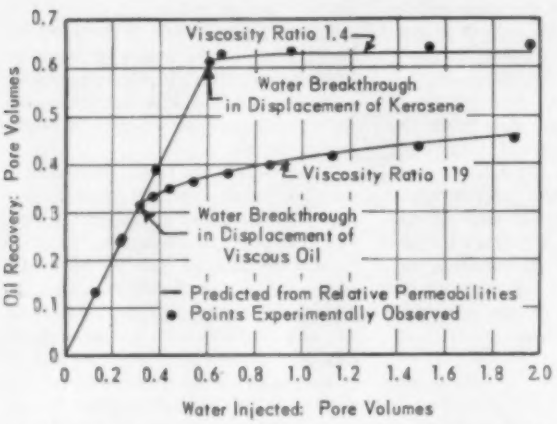

Fig. 22—Oil recovery as a function of quantity of water injected.

is independent of the rate of water advance when the capillary and gravitational forces are negligible. It is also important to determine if these forces cause recovery to a specified water-oil ratio to be rate-sensitive when they are not negligible.

Capillary forces . . . During displacement of oil by water, a "front," or wall of water, develops as illustrated schematically in Fig. 23. Because of the large differences in water saturation which exist just behind and just in advance of this "front," a large capillary pressure gradient is produced. This gradient causes water to move more rapidly than if the capillary forces were negligible and therefore tends to diffuse the "front." If an appreciable "spreading" of the front is produced, water will break through to the producing well earlier and less oil will be recovered at any water-oil ratio. The ratio of the capillary to applied pressure gradients determines the significance of the "spreading" action.

In 1953 Rapoport and Leas[40] presented the results of scaled experiments conducted to determine the range of flooding rates in which the influence of capillary forces is significant. The data in Table 3, calculated from that of Rapoport and Leas, show for four different formations and for different well spacing the critical rates below which a dependence of recovery on rate would be experienced.

The greater the distance between wells, the lower is the rate of flooding at which the rate becomes important. This does not imply that the front is less diffuse in a long reservoir than in a short reservoir flooded at the same rate but merely shows that a smaller fraction of a long reservoir is occupied by the diffuse front.

For normal well spacings in a homogeneous water-wet reservoir, no measurable effect of rate on the flooding behavior results from the influence of the capillary forces in the range of rates of practical importance. Even for wells as closely spaced as 330 ft. no effect of rate on recovery would occur when the rate of water advance exceeds 0.02 ft. per day (7½ ft. per year).

Gravitational forces . . . If the water and oil phases are of different densities, even in a horizontal reservoir, the water will tend to flow downward and displace the oil more rapidly at the base of the sand member than at the top. A "tilted front" will result, and for the same volumetric rate of injection water will reach producing wells earlier than if the front were not tilted.

The faster the reservoir is flooded, the smaller will be the ratio of vertical to horizontal flow and the less will be the tilt to the front. It appears qualitatively, therefore, that in a homogeneous sand an increase in flooding rate would result in a higher recovery prior to water breakthrough or prior to attainment of any specified water-oil ratio.

No experiments on the effects of changes in rate of flooding on oil recovery in which the ratios of gravitational pressure to applied pressure and to capillary pressure were representative of actual field flooding operations have been reported in the literature. Such experiments were performed recently in our laboratories.

In one set of experiments, a model was constructed to simulate a linear reservoir comprised of uniform sand with 151 md. permeability, 40 ft. in

TABLE 3—MINIMUM RATE AT WHICH RECOVERY IS INDEPENDENT OF RATE
(From Data of Rapoport and Leas[40])

(If reservoir flooded at rate in excess of value shown, no dependence of recovery on rate will be experienced)

Distance between wells, ft.	Feet per day			
	Bartlesville sandstone (285 md.)	Weiler sandstone (211 md.)	Torpedo sandstone (640 md.)	Devonian limestone (1,863 md.)
1,320	0.00047	0.00093	0.0043	0.0041
660	0.00094	0.00186	0.0086	0.0082
330	0.00188	0.00372	0.0173	0.0164

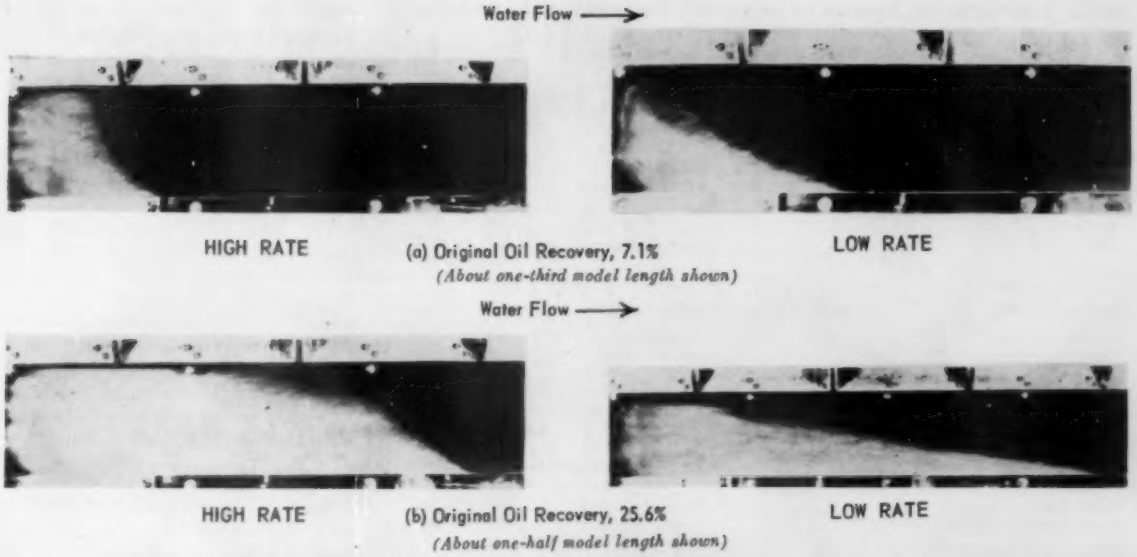

Fig. 24—Comparison of high and low rates of water flooding in high-permeability, uniform sand.

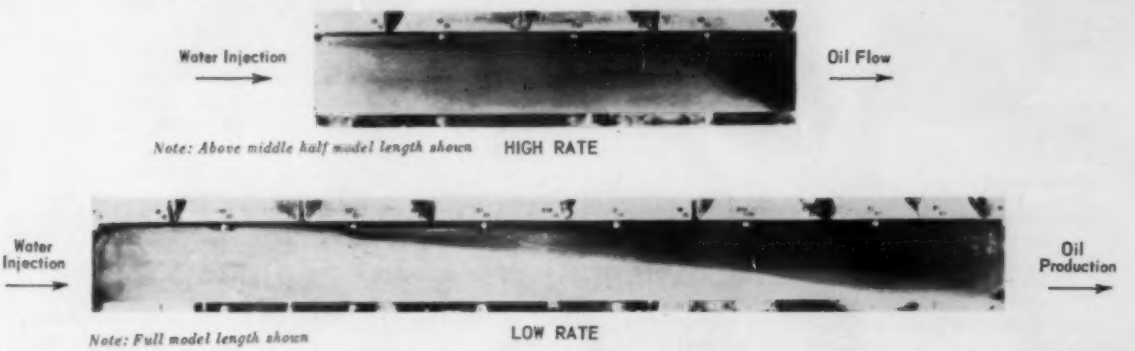

Fig. 25—Comparison of high and low rates of water flooding in high-permeability, uniform sand, 61 per cent original oil recovery.

thickness, and 490 ft. long. The characterists of the water and the oil were scaled to represent a density difference of 0.2 g. per cc. (0.087 psi. per ft. of column), a ratio of oil viscosity to water viscosity of 1.37, and an interfacial tension of 25 dynes per cm. The values of the variables in the experimental model and in its reservoir counterpart are compared in Table 4.

In the experiments, the viscous or applied pressure was about 17 times larger than the gravitational pressure when the reservoir was flooded to simulate a rate of 0.16 ft. per day and about 3.3 times larger than the gravitational pressure when flooded to simulate a rate of 0.03 ft. per day. At the lower rate, water breakthrough was observed after 70 per cent of the oil was recovered, while at the higher rate the oil recovery at breakthrough was 78 per cent.

Shape of front . . . Photographs taken during the experiments, Figs. 24 and 25, show the shapes of the water "front" at corresponding states of depletion for the two rates of injection. The front produced at the slow rate of flooding exhibited extreme tilting and occupied about half the reservoir length when water production commenced. At the high rate of injection, a rather stable tilted front was formed before water had progressed more than one-fourth the length of the reservoir.

At water breakthrough the front occupied approximately one-seventh of the length of the reservoir. Thus, in this homogeneous reservoir model a more uniform water advance was produced at the fast rate than at the slow rate of injection. However, the ultimate oil recoveries were about the same for the two rates.

In another set of experiments, the effect of rate in a thin, low-permeability sand was investigated. Here, oil was displaced by water at different rates from a simulated cylindrical reservoir 7.1 ft. in diameter, 1,280 ft. long, with a density difference between the water and oil of 0.2 g. per cc., a ratio of oil to water viscosity of 1.35, an interfacial tension of 30 dynes per cm., and a sand permeability of 20 md. Table 5 shows the corresponding values of the variables in the model and in this hypothetical reservoir.

The applied pressure was about 31 times larger than the gravitational pressure when the reservoir was flooded at a rate of 0.0026 ft. per day, and about 360 times larger than the gravitational pressure when flooded at 0.03 ft. per day. At the lower flooding rate, the oil production after water breakthrough was 4.2 per cent of the oil in place. At the higher rate, only 2.1 per cent of the oil in place was recovered after water breakthrough. The ultimate oil recoveries at both the high and low rates were the same. In neither of these experiments was there a significant influence of the combined capillary and gravitational forces on the oil recovery at water breakthrough.

From these data on both thick and thin homogeneous sands, it is con-

TABLE 4—SCALING OF VARIABLES IN MODEL EXPERIMENT TO REPRESENT RESERVOIR CONDITIONS
(High-permeability reservoir, uniform sand)

Property—	Value in model	Value in reservoir
Oil density, ρ_o	0.840 g./cc.	0.848 g./cc.
Water density, ρ_w	1.668 g./cc.	1.050 g./cc.
Density difference, $\rho_w - \rho_o$	0.828 g./cc.	0.202 g./cc.
Permeability, k	60,600 md.	151 md.
Porosity, ϕ	39.0 per cent	39.0 per cent
Height, H	5.85 in.	40 ft.
Length, L	71.5 in.	490 ft.
Thickness, T	0.25 in.	1.71 ft.
$\frac{\text{Length}}{\text{Height}} = L/H$	12.25	12.25
Oil viscosity, μ_o	8.48 cp.	0.98 cp.
Water viscosity, μ_w	6.2 cp.	0.72 cp.
$\frac{\text{Viscosity oil}}{\text{Viscosity water}} = \mu_o/\mu_w$	1.37	1.37
Interfacial tension, γ		
Rate 1	23.4 dynes/cm.	23.4 dynes/cm.
Rate 2	30.0 dynes/cm.	30.0 dynes/cm.
Flood Rate 1, q_1	31.4 ft./day	0.164 ft./day
Flood Rate 2, q_2	6.05 ft./day	0.032 ft./day
$\frac{\text{Gravitational pressure}}{\text{Capillary pressure}} = \frac{(\rho_w - \rho_o)\,gH}{\gamma\,(\phi/k)^{1/2}}$		
Rate 1	0.64	0.64
Rate 2	0.50	0.50
$\frac{\text{Viscous pressure}}{\text{Gravitational pressure}} = \frac{(q/k)\,\mu_w L}{(\rho_w - \rho_o)\,gH}$		
Rate 1	17.2	17.2
Rate 2	3.33	3.33
$\frac{\text{Viscous pressure}}{\text{Capillary pressure}} = \frac{(q/k)\,\mu_w L}{\gamma\,(\phi/k)^{1/2}}$		
Rate 1	11.0	11.0
Rate 2	1.67	1.67

TABLE 5—SCALING OF VARIABLES IN MODEL EXPERIMENT TO REPRESENT RESERVOIR CONDITIONS
(Low-permeability reservoir, uniform sand)

Property—	Value in model	Value in reservoir
Oil density, ρ_o	0.83 g./cc.	0.85 g./cc.
Water density, ρ_w	1.565 g./cc.	1.05 g./cc.
Density difference, $\rho_w - \rho_o$	0.735 g./cc.	0.20 g./cm.
Permeability, k	38,200 md.	20 md.
Porosity, ϕ	34.8 per cent	34.8 per cent
Diameter, D	0.53 in.	85 in.
Length, L	8 ft.	1,280 ft.
$\frac{\text{Length}}{\text{Diameter}} = L/D$	181	181
Oil viscosity, μ_o	5.65 cp.	0.97 cp.
Water viscosity, μ_w	4.18 cp.	0.72 cp.
$\frac{\text{Viscosity oil}}{\text{Viscosity water}} = \mu_o/\mu_w$	1.35	1.35
Interfacial tension, γ	30 dynes/cm.	30 dynes/cm.
Flood Rate 1, q_1	36.6 ft./day	0.03 ft./day
Flood Rate 2, q_2	3.2 ft./day	0.0026 ft./day
$\frac{\text{Gravitational pressure}}{\text{Capillary pressure}} = \frac{(\rho_w - \rho_o)\,gH}{\gamma\,(\phi/k)^{1/2}}$	0.034	0.034
$\frac{\text{Viscous pressure}}{\text{Gravitational pressure}} = \frac{(q/k)\,\mu_w L}{(\rho_w - \rho_o)\,gH}$		
Rate 1	359	359
Rate 2	31.0	31.0
$\frac{\text{Viscous pressure}}{\text{Capillary pressure}} = \frac{(q/k)\,\mu_w L}{\gamma\,(\phi/k)^{1/2}}$		
Rate 1	12.1	12.1
Rate 2	1.05	1.05

cluded that the amount of tilt of the water front is a function of the ratio of the applied pressure to the gravitational pressure. Whether or not this tilt exerts a significant influence on the fraction of the oil recovered before water breakthrough depends on the ratio of the length of the sand to its height.

For long, thin sands a given tilt may have little effect on the breakthrough recovery; but for shorter or thicker sands this same tilt may significantly lower breakthrough oil recovery. However, as discussed in a following section of this report, in nonhomogeneous reservoirs the influence of capillary forces will, in most cases, outweigh this effect.

Presence of Free Gas

Several investigators[41 42 43 44 45 46] have studied the effect of the presence of a free gas saturation upon the quantity of oil which is trapped and held as residual oil. All of these investigators found that for the systems they used the quantity of residual oil remaining after water flooding was decreased by the presence of a free gas saturation during the flood. The magnitude of the increase in recovery was found to be dependent upon the amount of free gas and upon the characteristics of the rock.

Kyte, Stanclift, Stephan, and Rapoport[45] reported that the flooding process in the presence of free gas occurs as two distinct two-phase displacements. In the first stage, most of the gas is displaced by oil with the creation of an immobile residual gas saturation. In the second stage, the oil and residual gas are displaced by water with a resulting final nonwetting residual saturation of both gas and oil. They demonstrated that the same oil recovery would be obtained if oil were first injected to displace the gas and then followed by injection of water or if water were injected initially to displace both gas and oil.

The results reported by Kyte, et al, which demonstrate that the recovery process consists of two distinct two-phase displacements, imply that the recovery will be independent of the rate in the presence of free gas. This implication is based on the fact that in the range of rates of practical interest both the oil-gas displacement and the water-oil displacement are independent of the rate at which the displacement is conducted; therefore, in the combination of these two displacements, it should not be expected that a reduction in rate would result in loss of oil.

In 1950, Dykstra and Parsons[44] presented the results of a series of

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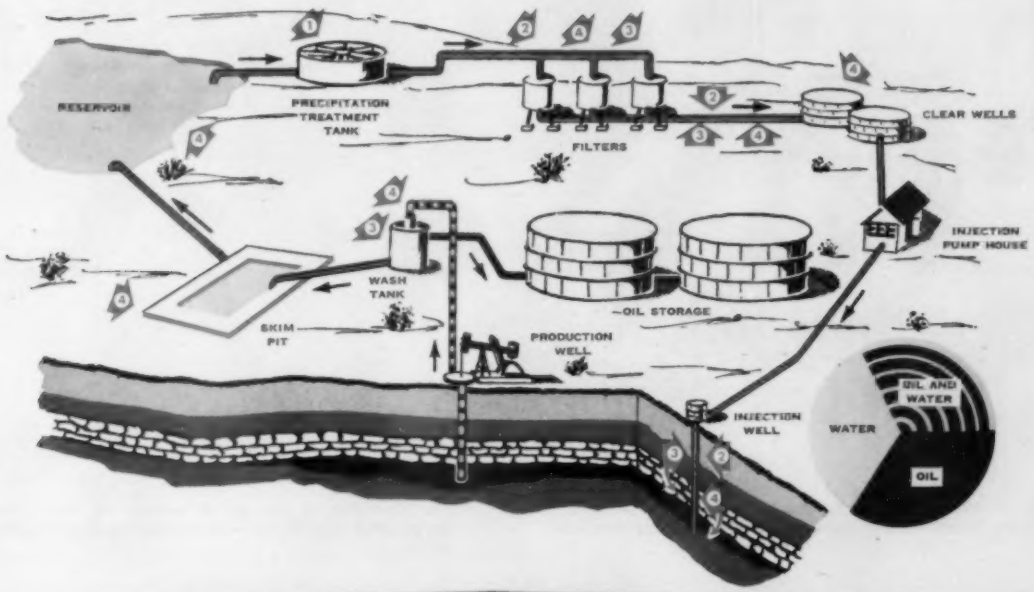

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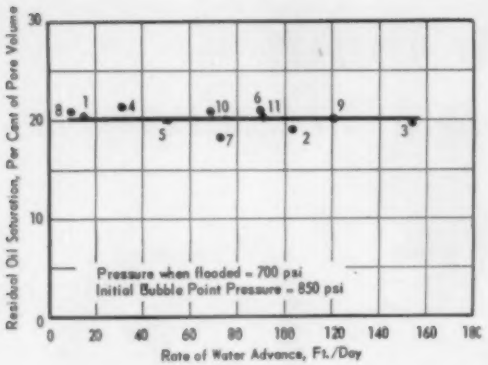
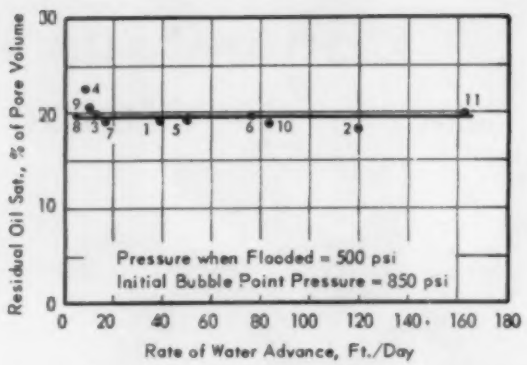

Residual Oil Saturation, Per Cent of Pore Volume
Rate of Water Advance, Ft./Day
Pressure when flooded = 700 psi
Initial Bubble Point Pressure = 850 psi

Experiment number	Free gas saturation at initiation of water flood, per cent of pore volume
1	7.0
2	7.2
3	6.4
4	5.9
5	5.7
6	5.7
7	6.8
8	6.6
9	6.0
10	6.0
11	6.1

Fig. 26—Effect of rate on oil recovery by water flooding in presence of a 6 per cent free-gas saturation (homogeneous sand).


Residual Oil Sat., % of Pore Volume
Rate of Water Advance, Ft./Day
Pressure when Flooded = 500 psi
Initial Bubble Point Pressure = 850 psi

Experiment number	Free gas saturation at initiation of water flood, per cent of pore volume
1	15.5
2	13.6
3	12.9
4	12.7
5	11.8
6	13.1
7	14.2
8	11.6
9	11.8
10	11.8
11	12.2

Fig. 27—Effect of rate on oil recovery by water flooding in the presence of a 12 per cent free-gas saturation (homogeneous sand).

laboratory tests in which, in separate experiments, 30 cores were flooded at rates of water advance ranging from 0.2 to 85 ft. per day. In each case, the cores contained 30 per cent water, 50 per cent oil, and 20 per cent gas saturations at the initiation of the floods. The recovery was observed at produced water-oil ratios of 1 and 25. From these data they concluded: ". . . the results show that, for nominal rates of flow, the recovery is practically independent of the rate of flow."

Opposing results . . . Bass and Crawford,[48] in 1955, reported experimental results which disagree with those of Dykstra and Parsons and which are at variance with the interpretation of the work of Kyte, et al, presented above. Two sets of experiments were performed; in each case, a fairly viscous oil and a relatively high initial water saturation were used. In one set, oil was displaced by water at a rate of water advance of about 18 ft. per day. Separate displacements were performed with varying initial free-gas saturations. In the other set, the flooding was accomplished at a rate of water advance of about 4 ft. per day.

The authors reported that, with initial gas saturations of 5 per cent and of 30 per cent, oil recovery was greater at a flooding rate of 18 ft. per day than at 4 ft. per day, but at a gas saturation of about 15 per cent the opposite was observed.

Four sets of experiments similar to those of Bass and Crawford have been performed in Humble's laboratories. Short sand-packed columns were prepared to contain original saturations of about 10 per cent connate water and about 90 per cent kerosine saturated with methane. In each set, separate displacements were performed at various rates of flooding. Residual oil saturations were then determined and plotted as a function of the rate of water advance. Any significant influence of rate on recovery should be reflected on such plots as a deviation of the trend from the horizontal.

Proper scaling . . . To insure that the oil recovery from such columns prior to attainment of any specified water-oil ratio is representative of a similar flood over a much longer distance as experienced in a reservoir, it is necessary that the experiments be so designed that the influence of capillary and gravitational forces are of the same relative importance as in the field.

In these experiments, the influence of gravitational forces was negligible; hence, it was only necessary that the influence of the capillary forces be properly "scaled." This requires that the ratio of the capillary pressure gradient to the applied pressure gradient be the same in the laboratory as that expected in the reservoir. This condition is satisfied for rocks of given characteristics by the use of fluids with the same viscosities as the reservoir fluids and by investigating a range of rates such that the product of rate times flooding distance is identical for both reservoir and laboratory.

For example, to stimulate a flood advancing at 0.1 ft. per day over a distance of 1,000 ft. in the reservoir, the experiment should be conducted with a reservoir-equivalent rock and reservoir-equivalent fluids at a flooding rate of 100 ft. per day in a 1-ft. column, or 50 ft. per day in a 2-ft. column, or 10 ft. per day in a 10-ft. column, etc. To fulfill this condition with laboratory experiments in 3-ft. sand columns, the range of rates which must be investigated will thus greatly exceed actual field rates. It is possible to achieve the required scaling by increasing the flooding rate because of the observation that the relative permeabilities to oil and water are not dependent upon the rate of flooding.

Humble experiments . . . In the first set of Humble experiments, water flood were conducted at 950 psi., 100 psi. above bubble point, at different

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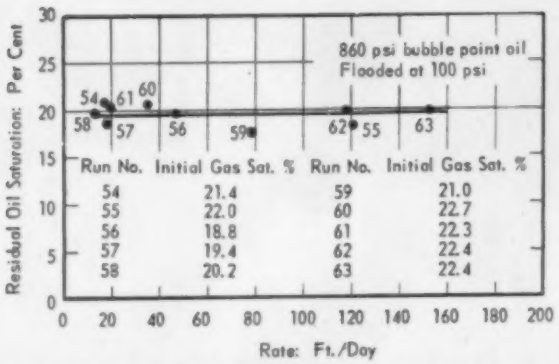
Residual Oil Saturation: Per Cent
860 psi bubble point oil
Flooded at 100 psi
Run No. Initial Gas Sat. % Run No. Initial Gas Sat. %
54 21.4 59 21.0
55 22.0 60 22.7
56 18.8 61 22.3
57 19.4 62 22.4
58 20.2 63 22.4
Rate: Ft./Day

Fig. 28—Effect of rate on oil recovery by water flooding in presence of a 22 per cent free-gas saturation (homogeneous sand).

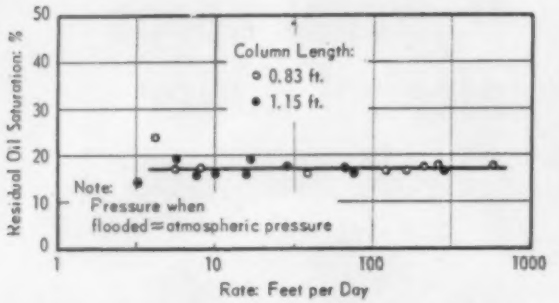

Fig. 30—Effect of rate on oil recovery by water flooding in presence of a 6-9 per cent free-gas saturation (homogeneous sand).

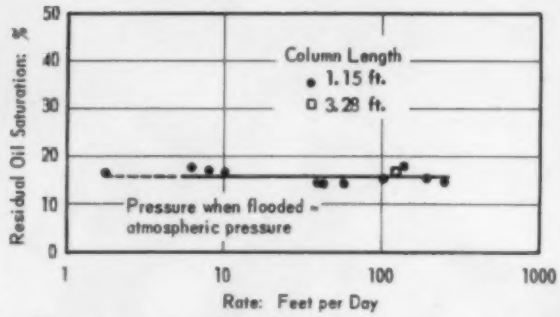

Fig. 29—Effect of rate on oil recovery by water flooding with no free gas (homogeneous sand).

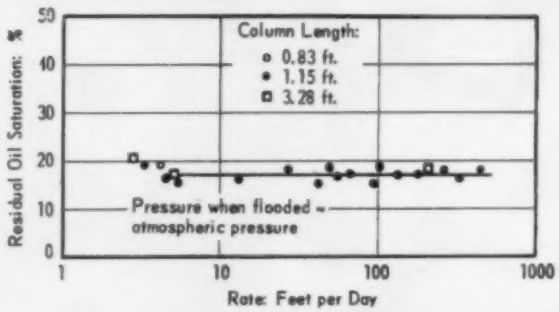

Fig. 31—Effect of rate on oil recovery by water flooding in presence of a 13-16 per cent free-gas saturation (homogeneous sand).

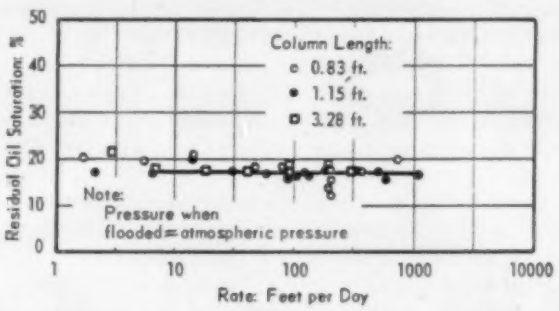

Fig. 32—Effect of rate on oil recovery by water flooding in presence of a 24-26 per cent free-gas saturation (homogeneous sand).

rates of injection to observe the effect of the rate on recovery with no free gas present in the homogeneous reservoir. This set of experiments has been described previously and results are shown in Fig. 18. Conclusions are that the residual oil saturation is independent of the flooding rate when no free gas is present.

In the second set of experiments, dissolved-gas drives were performed from the initial bubble-point pressure of 850 psi. to a pressure of 700 psi. prior to water flooding at the latter pressure. The gas saturation at the initiation of the water flood was about 6 to 7 per cent. Fig. 26 is a plot of the results of 11 experiments conducted in the homogeneous model at water-flooding rates varying from 10 to 154 ft. per day. The residual oil saturation was completely independent of the rate of flooding within the limits of experimental uncertainty.

The third set of experiments consisted of a series of water floods conducted at a pressure of 500 psi. following dissolved-gas drives performed from the bubble-point pressure to a pressure of 500 psi. The gas saturation at the initiation of the water flood in this case was about 12 per cent. Fig. 27 shows the results of 11 experiments performed in the range of rates from 5 to 163 ft. per day. Again, no dependence of recovery on rate was observed in the homogeneous sand.

Similar procedures were followed in the fourth set of experiments. Water floods were initiated after the pressure of the dissolved-gas-drive production had dropped to 100 psi. In these runs the initial gas saturation was approximately 22 per cent. The flooding rates for the 10 experiments varied from 13 to 153 ft. per day. The residual oil saturation in the homogeneous sand was again independent of rate as shown in Fig. 28. Recall that these four sets of experiments were so scaled that the relatively high rates of flooding investigated in the laboratory are equivalent to the range of reservoir rates of practical interest.

A further series of flooding experiments was conducted at atmospheric pressure in Humble's laboratories. For each of four initial gas saturations studied (0 per cent, 6 to 9 per cent, 13 to 16 per cent, 24 to 26 per cent), runs were made at rates ranging from 1.7 to 1,115 ft. per day in columns of three different lengths (0.83, 1.15, and 3.28 ft.). In the three sets of experiments in which an initial gas phase was introduced, mobile gas was produced prior to the production of oil. In each case, the gas saturation was reduced from its initial value to 3 to 4 per cent at the start of oil production and remained at that value to the end of the flood. The data for residual oil saturation as a function of flooding rate are plotted on Figs. 29, 30, 31, and 32. The results of

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these low-pressure experiments, conducted in homogeneous sands, indicate that rate of flooding does not affect recovery.

From these experiments conducted by Humble, as well as from the work of others,[44 45] it can be concluded that in homogeneous sands the presence of a free-gas saturation does not produce a dependence of oil recovery upon rate. It might also be pointed out that in these flooding experiments conducted in Humble's laboratories on unconsolidated sands the presence of free gas over a fairly wide range of saturation during the displacement by water resulted in only a small increase in ultimate oil recovery.

Solution of free gas . . . In the flooding of a depleted reservoir, the pressure in the oil bank may be considerably higher than the pressure at the oil-gas front. This means that the pressure on the trapped residual gas may increase sufficiently to dissolve the trapped gas in the oil. In such a case, the water-flood front will encounter only an oil phase, and the increase in ultimate recovery that might possibly result from the presence of free gas during the water displacement will be forfeited.

The amount that the pressure on the trapped gas will be increased in the oil bank is a function of the rate at which the flood is conducted; the more rapid the flood, the greater will be the pressure increase on the trapped gas and the greater the tendency of the gas to dissolve in the oil.

Holmgren and Morse[42] have suggested that the free-gas saturation can be maintained by injection of a gas of low solubility prior to flooding to increase the reservoir pressure to such a level that the pressure difference across the oil bank will be a small fraction of the absolute pressure. In the absence of some repressuring procedure, the trapped gas in a depleted reservoir will undoubtedly be dissolved. For instance, for a reservoir depleted to a pressure of 100 psi., an increase of only 17 psi. would be sufficient to redissolve a 10 per cent trapped methane saturation in a light oil. If the pressure at time of initiation of the flood were 200 psi., an increase of about 35 psi. would dissolve the 10 per cent gas saturation.

While the exact numbers vary depending on the properties of the oil and the gas, the magnitude of the pressure increase required to redissolve the gas will not vary appreciably; therefore, in the typical flood of a depleted reservoir, the final displacement is usually of oil by water with no free gas. The evidence for this type of displacement clearly shows that in the range of rates of interest no loss in oil recovery will result from a reduction in rate.

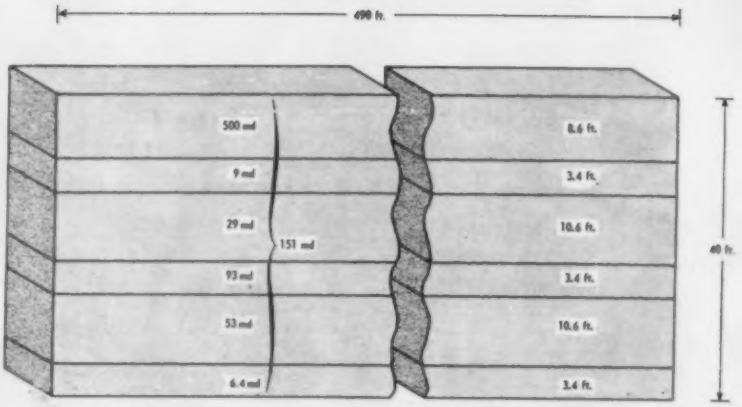


Fig. 33—Illustration of the simulated stratified reservoir with individual and over-all stratum lengths, heights, and permeabilities.

Heterogeneous Water-Wet Sands

Variations of size, sorting, and degree of consolidation of sand grains in adjacent portions of the reservoir cause variations in the permeability and capillary pressure of the reservoir rock. The influence of these heterogeneities on the over-all flooding behavior of the reservoir can be deduced from the same basic concepts of fluid movement in porous media discussed in connection with the flooding of homogeneous sands. It is only necessary to consider how the variations in rock texture will modify the interrelations of viscous, capillary, and gravitational forces.

Separated sand strata . . . Uniform sand strata separated by impermeable layers are simply homogeneous sands connected only through the injection and production wells. The flooding of each stratum occurs independently of events in the others. Since recovery from a single homogeneous reservoir is not affected by curtailment of rate, the recovery from two or more such reservoirs under simultaneous flood likewise will not be diminished by decreased rates of flooding.

In the range of rates in which capillary pressure gradients do not exert an appreciable effect on the displacing front, i.e., at all rates of practical importance, the fraction of the total water injected which enters each sand is independent of the injection pressure and is determined solely by the viscosities of the oils and by the effective permeabilities of the individual sand members. Thus, the relative rates of flooding of multiple strata cannot be altered by a change in the injection pressure. Water production can commence from one stratum when the other is only partially depleted; attempts to alter or avoid this circumstance by changes in the injection pressure would only result in a change in the time required to complete the flooding operation.

Strata with vertical flow . . . The absence of a vertical barrier to flow between two sand strata permits interchange of fluids between the two sands. The initial distribution of water and oil in the sands must be such that the capillary pressure and gravitational forces are in balance. As water invades the more permeable sand, the capillary equilibrium is upset, and water will begin to be imbibed spontaneously into the less permeable sand to restore equilibrium.

Thus, the more permeable sand will act as a source of water for the less permeable, and a more uniform flood will result than if there were a barrier to vertical flow. However, imbibition progresses slowly; if a flood is rapid, the beneficial effects of imbibition will not be fully realized. At slower rates a more uniform flooding of the two strata will be obtained. The rate of flooding at which uniformity can be attained will depend, in part, upon the thickness of the sand of lower permeability. If the sand is thin, the imbibition can be very effective.

Experiments have been performed in Humble's laboratories to demonstrate the importance of flooding stratified reservoirs at a sufficiently low rate to take advantage of imbibition. In one such set of experiments, a stratified "reservoir" 6 ft. long and 6 in. in height was constructed; in the reservoir were six sand strata, each of a different permeability and in capillary contact with adjacent strata. The stratified reservoir simulated by this laboratory model is illustrated in Fig. 33. The individual stratum lengths, heights, and permeabilities are

shown as well as the over-all values. The permeability variations were selected to be representative of the type of permeability profile in actual reservoirs. The pertinent variables in the model and in the scaled reservoir are compared in Table 6.

Floods were performed at two simulated rates of advance, one at 0.03 ft. per day and the other at about 0.17 ft. per day. Fig. 34 shows photographs of two displacements after approximately 0.1 pore volume of water had been injected. Figs. 35 and 36 show the areas invaded by water at corresponding stages of injection for two different rates of injection. At the higher rate, water production began after 0.26 pore volume of oil was recovered, but at the lower rate 0.42 pore volume of oil was recovered before any water was produced.

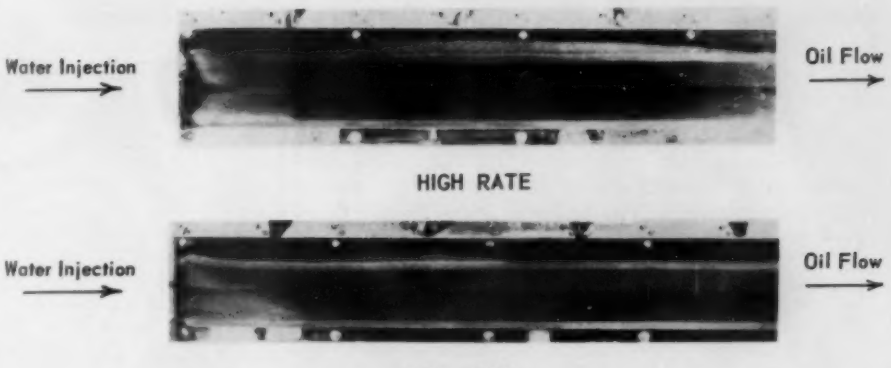


Fig. 34—Comparison of high and low rates of water flooding in stratified sand, 0.10 pore volume water injected.

At the high injection rate, the flushing of the 9-md. sand by imbibition was relatively ineffective, and the water front moved disproportionately rapidly through the 500-md. sand. At the low rate of injection, water invasion of the 9-md. sand by imbibition retarded the channeling of water through the 500-md. sand, and the water front advanced nearly uniformly through both the coarse and the tight sands.

Similarly, flow of water by gravity and imbibition occurred into all the sands underlying the 9-md. sand. This contributed to flushing of the lower sands in advance of the main water front at the slow rate but was ineffective at higher rate of injection.

The ultimate recovery for the floods at these two rates of injection was about the same, although more water was required at the higher rate. Although the behavior of this example is representative only of a reservoir of the specified properties, these results illustrate that in reservoirs which are appreciably nonuniform in rock properties a lower rate of water injection will produce a more uniform water advance than will a higher rate.

The importance of flooding at a rate which will take advantage of the action of capillary forces in the flushing of low-permeability strata can be emphasized by comparing the floods shown in Figs. 24 and 25 with those just described. The ratios of viscous to gravitational forces and viscous to capillary forces in the homogeneous reservoir were nearly identical to the over-all ratios of forces pertinent to the floods conducted in the stratified models. Whereas in the homogeneous reservoir the higher rate resulted in a more uniform displacement, in the more realistic, nonuniform reservoir, the opposite was observed in that a decrease in rate re-

TABLE 6—SCALING OF VARIABLES IN MODEL EXPERIMENT TO REPRESENT RESERVOIR CONDITIONS
(Stratified reservoir)

Property—	Value in model	Value in reservoir
Oil density, ρ_o	0.840 g./cc.	0.854 g./cc.
Water density, ρ_w	1.666 g./cc.	1.050 g./cc.
Density difference, $\rho_w - \rho_o$	0.826 g./cc.	0.196 g./cc.
Permeability, k_1	189,000 md.	500 md.
Permeability, k_2	3,300 md.	8.7 md.
Permeability, k_3	10,800 md.	29 md.
Permeability, k_4	35,000 md.	93 md.
Permeability, k_5	20,000 md.	53 md.
Permeability, k_6	2,400 md.	6.4 md.
Permeability, over-all	57,200 md.	151 md.
Porosity, over-all	39.8 per cent	39.8 per cent
Height, H_1	1.25 in.	8.6 ft.
Height, H_2	0.50 in.	3.4 ft.
Height, H_3	1.55 in.	10.6 ft.
Height, H_4	0.50 in.	3.4 ft.
Height, H_5	1.55 in.	10.6 ft.
Height, H_6	0.50 in.	3.4 ft.
Height, over-all	5.85 in.	40 ft.
Length, L	71.5 in.	490 ft.
Thickness, T	0.25 in.	1.71 ft.
$\frac{\text{Length}}{\text{Height}} = L/H$	12.25	12.25
Oil viscosity, μ_o	8.54 cp.	0.99 cp.
Water viscosity, μ_w	6.2 cp.	0.72 cp.
$\frac{\text{Viscosity oil}}{\text{Viscosity water}} = \mu_o/\mu_w$	1.38	1.38
Interfacial tension, γ		
Rate 1	23.0 dynes/cm.	23.0 dynes/cm.
Rate 2	25.7 dynes/cm.	25.7 dynes/cm.
Flood Rate 1, q_1	31.3 ft./day	0.169 ft./day
Flood Rate 2, q_2	6.25 ft./day	0.034 ft./day
$\frac{\text{Gravitational pressure}}{\text{Capillary pressure}} = \frac{(\rho_w - \rho_o)\,gH}{\gamma\,(\phi/k)^{1/2}}$		
Rate 1	0.63	0.63
Rate 2	0.56	0.56
$\frac{\text{Viscous pressure}}{\text{Gravitational pressure}} = \frac{(q/k)\,\mu_w L}{(\rho_w - \rho_o)\,gH}$		
Rate 1	18.2	18.2
Rate 2	3.64	3.64
$\frac{\text{Viscous pressure}}{\text{Capillary pressure}} = \frac{(q/k)\,\mu_w L}{\gamma\,(\phi/k)^{1/2}}$		
Rate 1	11.5	11.5
Rate 2	2.04	2.04

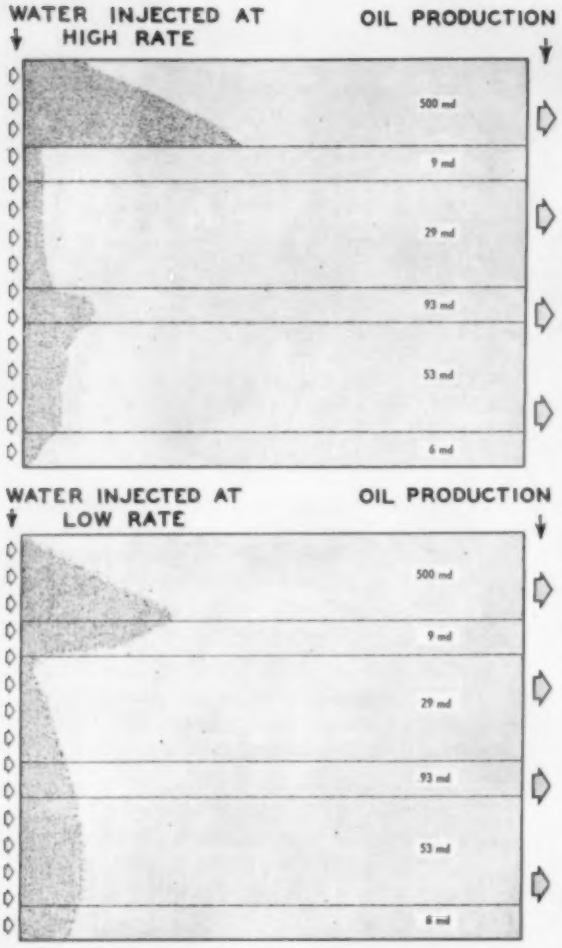


Fig. 35—Comparison of water sweepout in stratified sand at high and low rates, at 0.10 pore volume water injected. (Reservoir 490 ft. long, 40 ft. high.)

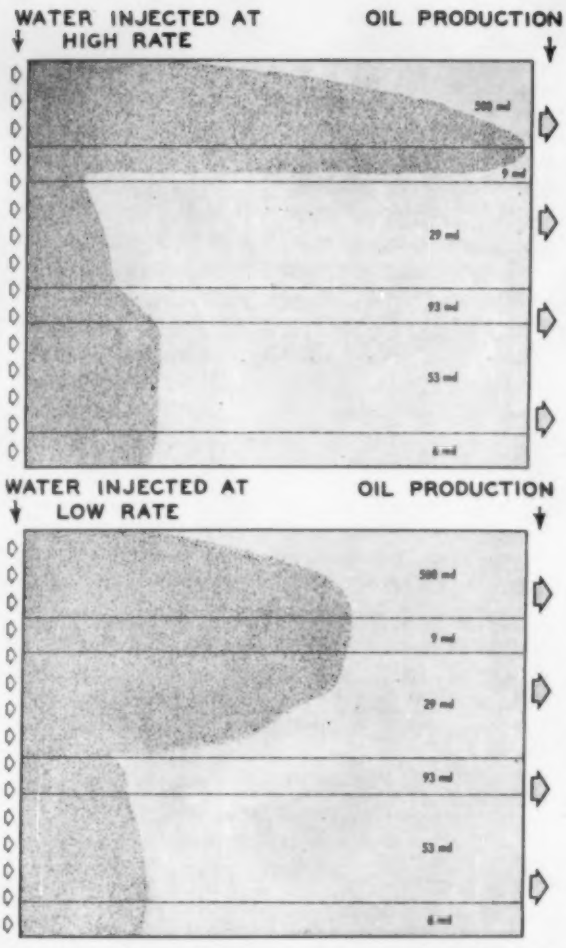


Fig. 36—Comparison of water sweepout in stratified sand at high and low rates, at 0.26 pore volume water injected. (Reservoir 490 ft. long, 40 ft. high.)

sulted in more effective displacement.

Lenses in a main sand . . . As in the case of stratified reservoirs, the initial distribution of oil, water, and gas in a reservoir of this type will be such that a capillary-gravitational equilibrium exists. This normally implies a higher water and lower oil saturation in the "tight lenses" than in the main sand.

When a displacing water front reaches a lens, the relative rates of advance through the lens and through the main sand are determined by the rate at which water is supplied, by the relative magnitudes of the permeabilities and capillary pressures, and by the size of the lens. At low rates water tends to flood the tight lens first. At higher rates, water tends to flow more rapidly through the main sand, bypassing oil in the tight lens.

The reason for this behavior is similar to that for stratified sands and has a simple explanation. If water is supplied slowly to a small lens, the capillary pressure gradients in the main sand and in the lens cause the water saturations in both the lens and the surrounding sand to increase; the capillary pressure in the lens and in the main sand remain equal. If the capillary pressure-saturation relations are widely different in the two sands, almost all of the oil can be displaced from the lens by imbibition before appreciable displacement of oil from the main sand has occurred.

Fig. 37 shows illustrative capillary-pressure curves for a low and for a high-permeability sand. If the initial capillary pressure were 20 psi., the oil saturation in the lens would be 65 per cent, that in the main sand 71 per cent. During imbibition, when capillary pressure has decreased to 3 psi., the saturation in the lens will have decreased to 43 per cent, but that in the main sand to only 67 per cent. The flushing of the main sand by the advancing water front will continue.

At a higher rate, or in a larger lens, water may be supplied faster than it can enter the lens by imbibition, and water will flow past the lens through the more permeable sand. If the rate is sufficiently high, the water can surround the lens before the oil is displaced from the lens. Although the oil will continue to be displaced from the lens to the main sand by imbibition, the oil behind the main displacement front may not be recovered before a high water-oil ratio necessitates abandonment.

To determine how serious this loss of oil might be, Leverett[47] et al., conducted experiments carefully scaled to represent field flooding operations. Fig. 38, taken from this paper, illustrates the loss in recovery resulting from bypassing of oil at high rates. After injection of one pore volume of water at a rate of 1.56 ft. per day, 40 per cent of the oil from the fine sand was recovered; but at a rate of 62.5 ft. per day, only 21 per cent of the oil was recovered from the lens.

These results demonstrate that dis-

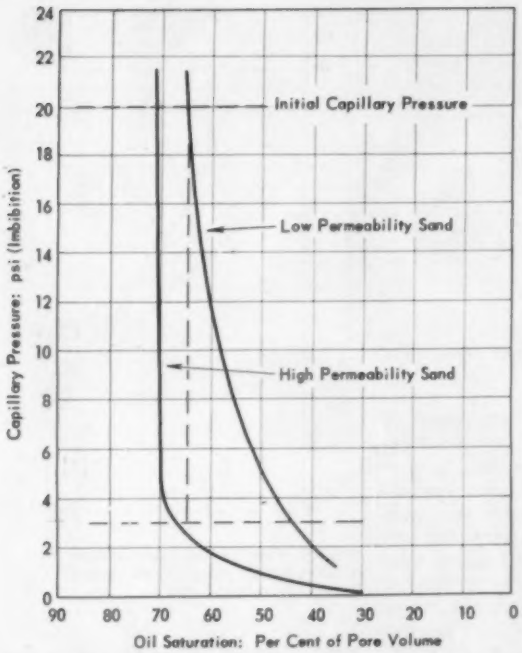

Capillary Pressure: psi (Imbibition)
Initial Capillary Pressure
Low Permeability Sand
High Permeability Sand
Oil Saturation: Per Cent of Pore Volume

Fig. 37—Illustrative imbibition capillary-pressure curves for low-permeability and high-permeability sands.

placement of oil from a lens is more efficient at a low rate of water advance than at a high rate.

Oil-Wet Sands

Reservoir rocks that are completely and preferentially oil-wet are believed, according to Muskat,[48] to be rare if existent at all. In an oil-wet reservoir, the flooding characteristics are appreciably different from those of a water-wet reservoir. The oil is never broken into discontinuous globules; at the end of the displacement, it occupies the portions of the pore space otherwise occupied by connate water. This results because the flooding process consists of displacement of a wetting phase by a nonwetting phase, rather than the previous (water wet) case of displacement of nonwetting phase by a wetting phase.

However, the conclusions drawn regarding the effect of rate on oil recovery in a homogeneous oil-wet reservoir are similar to those for the water-wet case. If capillary and gravitational forces are not significant, then the displacement is dependent only upon the relative permeabilities at different saturations and upon the fluid viscosities. The influence of capillary forces again causes the recovery to a specified water-oil ratio to be rate-sensitive at very low rates. As in the water-wet rock with the same capillary pressure and permeability characteristics, recovery is not damaged by reduction in rate in the range of rates of interest (see Table 3 and Fig. 39). The influence of gravity is also the same as in the water-wet case.

In an oil-wet reservoir which contains lenses of low permeability or strata of different permeability, there would be no tendency for water to imbibe into the low-permeability rocks. There would, however, be a tendency for the oil to imbibe from the tight lens or strata into the surrounding flooded-out higher-permeability rock to maintain equivalence of the capillary pressure. Again, a lower rate would allow the imbibition process to be more effective and would result in more efficient displacement of oil by water.

Sands of Intermediate Wettability

A reservoir can be imagined which is neither strongly oil-wet nor strongly water-wet. Also, a situation can be postulated in which part of the rock surfaces are originally covered by oil, but in the presence of water become water-wet (a situation of this type undoubtedly resulted in the 100 per cent oil-saturated sand column of Newcombe[31] et al.).

The fluid mechanics of water flooding in such systems has received but little attention and appears to be extremely complex. The microscopic displacement might no longer be dominated by capillary forces, or it might be dominated by capillary forces at low rates and by viscous forces at relatively high rates. This behavior would be manifested as a dependence of relative permeability upon rate and may possibly occur in the range of rates of interest. The criteria for scaling of experiments in systems of this type cannot be unambiguously stated at the present time. Much research will be required before the effect of

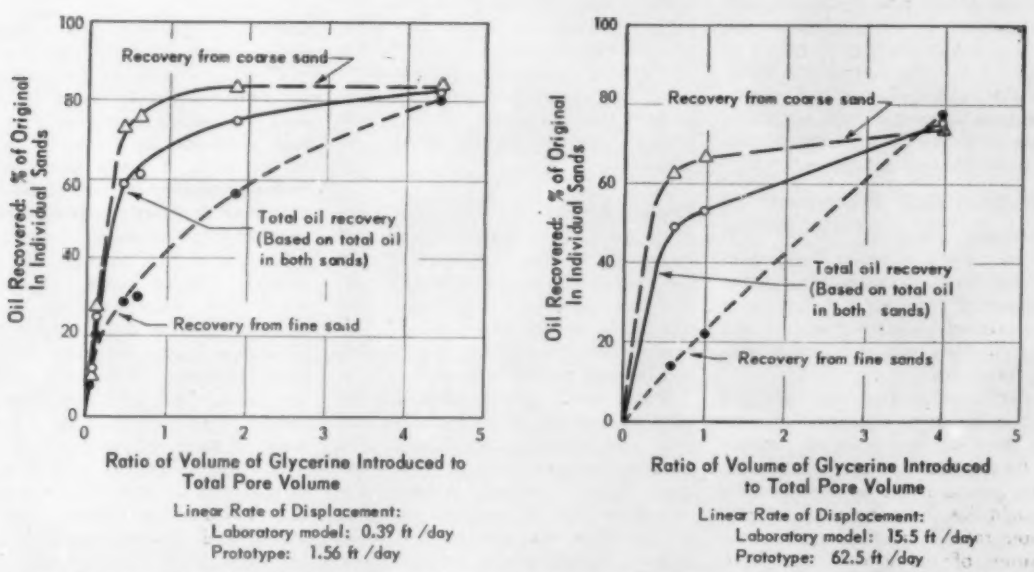

Oil Recovered: % of Original In Individual Sands
Recovery from coarse sand
Total oil recovery (Based on total oil in both sands)
Recovery from fine sand
Ratio of Volume of Glycerine Introduced to Total Pore Volume
Linear Rate of Displacement:
Laboratory model: 0.39 ft /day
Prototype: 1.56 ft /day
Oil Recovered: % of Original In Individual Sands
Recovery from coarse sand
Total oil recovery (Based on total oil in both sands)
Recovery from fine sands
Ratio of Volume of Glycerine Introduced to Total Pore Volume
Linear Rate of Displacement:
Laboratory model: 15.5 ft /day
Prototype: 62.5 ft /day

Fig. 38—Effect of rate on water-drive recovery from no nuniform sands. (From Leverett, Lewis, and True.[47])

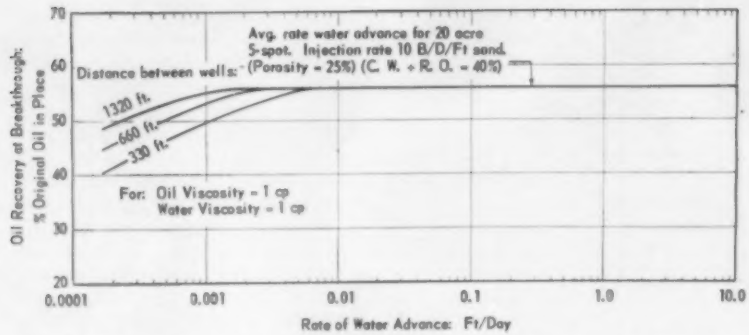


Fig. 39—Effect of rate of water advance on oil recovery at breakthrough. (Data from Rapoport and Leas.[40])

rate on recovery from such systems can be fully described.

Conclusions from Laboratory Studies

In reservoirs which are either water-wet or oil-wet and do not change during flooding, the effect of rate on recovery can be stated as follows: At rates practicable in a conventional water flood, residual oil saturation is not adversely affected by curtailment of rate. At all rates of interest in water flooding a homogeneous reservoir with negligible gravitational segregation, recovery prior to attainment of any specified water-oil ratio is not reduced by a restriction of rate. In non-homogeneous, stratified, communicating reservoirs or reservoirs consisting of lenses of low-permeability sand embedded in a higher-permeability sand body, a high flood rate may cause a loss of recovery prior to attainment of uneconomic water-oil ratios. The presence of a free gas phase at the initiation of a flood of a depleted reservoir does not alter the conclusions stated above.

Analysis of Field Data Purported To Show an Effect of Rate

In the light of the foregoing field and theoretical studies and laboratory experimentation, we have analyzed the histories of several water floods in Pennsylvania (Bradford), Kansas, and Oklahoma where rate of flooding has been reported to have influenced oil recovery. Interpretations by others of the behavior of the Kansas and Oklahoma floods have formed the nucleus of requests before the Railroad Commission of Texas for capacity production from water-flood properties.

Bradford Field, Pennsylvania

Extensive studies[13 19 49 50 51 52 53] have been made of water flooding in Bradford field, Pennsylvania. Some investigators[50 51 52] have contended that increased pressure gradients and higher injection rates yield higher ultimate recoveries.

Ryder[50] analyzed several Bradford floods in terms of a method that assumes that the decline in oil production from a flood under constant injection pressure can be described by a straight line if the logarithm of production rate is plotted against the logarithm of the age of the flood. Fig. 40 presents in this manner the production history of the Lincoln property in East Bradford.

Ryder pointed out that each time the injection pressure was increased there was a resultant increase in production rate. Moreover, as the injection pressure increased, the slope progressively decreased so that the log of the production rate declined more slowly with the log of time. He concluded that increases in injection pressure lead to greater ultimate oil recovery.

Plotting method . . . With logarithmic coordinates, it is possible by proper choice of variables to obtain a straight line over a short interval of any relatively smooth sequence of data. Often this leads to the unwarranted conclusion that this straight-line portion can be used for extrapolation.

Ryder used a time scale for his plots so that the initial 6 months' decline was approximately linear. The concave upward trend of the subsequent history strongly suggests the possibility that by properly choosing a time scale, the data for the entire history, including the rate changes, can be made to approximate a straight

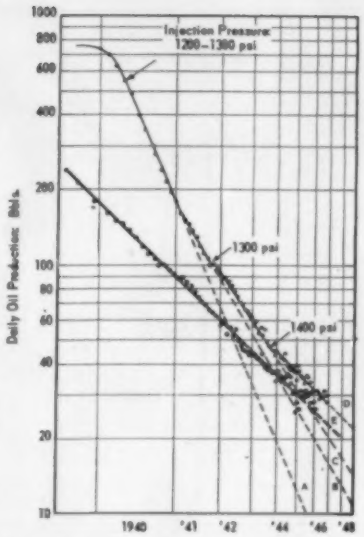


Fig. 40—Analysis of interpretation from a Bradford field flood (from data of Ryder, Prod. Mon., May 1947).

line. Such an adjustment has been made by shifting the curve to the left by 12 months; the resulting curve has been drawn on Fig. 40 as line E.

No influence of the increase in injection pressure on production decline can be observed in curve E. It should be emphasized that it is improper to attach any physical significance to a downward or upward change in slope which may occur by virtue of the properties of the coordinate system alone. Data were not available to make the more complete analysis of the flood which is possible by comparing cumulative production and water injected as described previously.

Realistic comparison . . . The relationship between flood performance and rate was evaluated by this technique for certain other leases in Bradford field for which complete data had been published by Fettke.[14] In Fig. 41 are plots of water injection rate and cumulative oil and total fluid produced as functions of cumulative water injected for two of these floods.

In each of these examples, at fillup, a linear relation exists between the amount of water injected and the amount of oil produced. After water production began, the total fluid produced continued to increase more or less linearly with injection. However, the oil rate declined as the produced water-oil ratio increased.

In these floods, fluctuations in rate of injection did not disturb the relation between the injected and produced fluids despite threefold to tenfold changes in injection rate during the history of the projects. As ob-

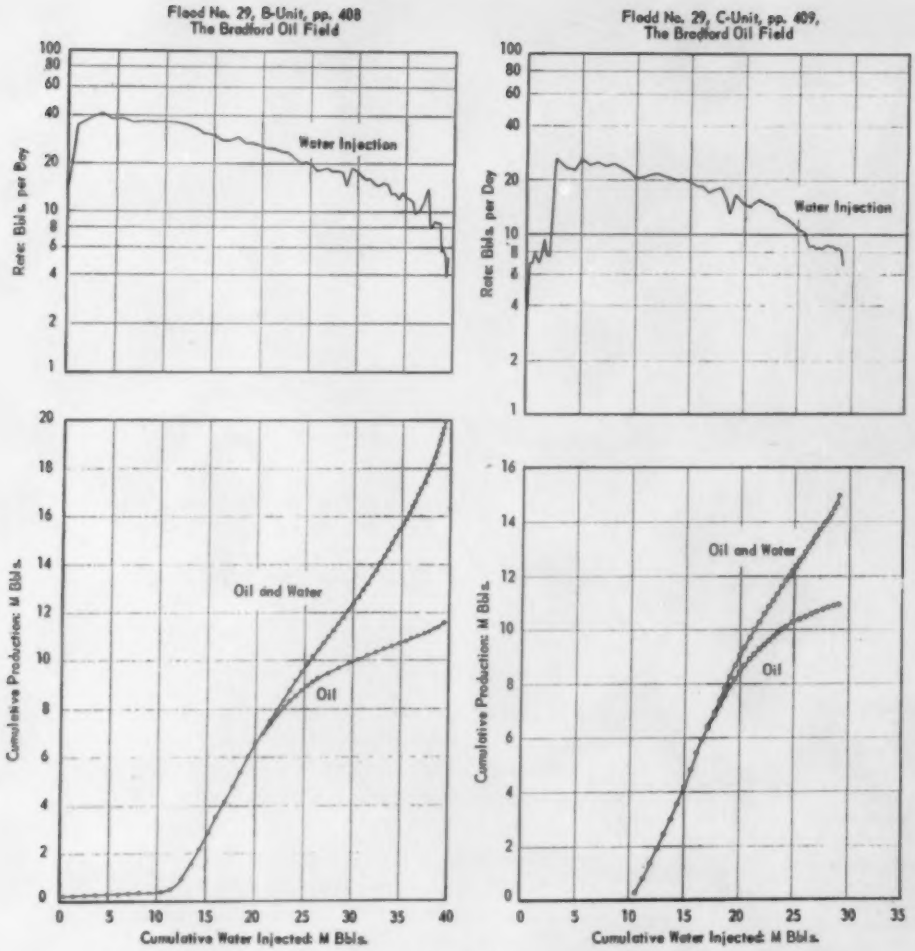


Fig. 41—Relation between fluid production and water injection—Bradford field floods.

served from the smoothness of the oil curve, the volume of oil produced as a result of injecting a unit volume of water was not dependent on the rate at which the water was injected. Thus the changes in injection rates had no detectable effect on the flood performances or on the ultimate recoveries.

Lynde, Walter, and Darby Lease "C," Neosho County, Kansas

In January 1950, Forest Oil Corp. submitted to the Railroad Commission of Texas the history of a water flood in eastern Kansas (see Fig. 42) as evidence (Exhibit I-1) supporting its request for capacity producing rates for their South Ward flood. Forest contended that capacity rates are necessary to avoid waste. These data are identical with and are presumed to be for the flood of the Lynde, Walter, and Darby Lease "C," Neosho County, Kansas.[24]

Forest claimed that the history of this flood showed that curtailment of injection rate early in the flood's life had caused loss of ultimate oil recovery. Oil production reached a peak near the middle of 1942 and at a constant rate of water injection of 1800 to 1900 bbl. per day "... started on a straight-line decline curve on semilog paper, which trend is customary for water floods." Forest's personnel extrapolated this decline curve to the economic limit and predicted the amount of oil which ultimately would have been recovered had that constant rate of injection been continued. They asserted that the decreased water-injection rates beginning in 1943 resulted in a deviation in the oil production curve from the normal trend and that 25,000 bbl., 7 per cent of the ultimate flood oil recovery, were lost.

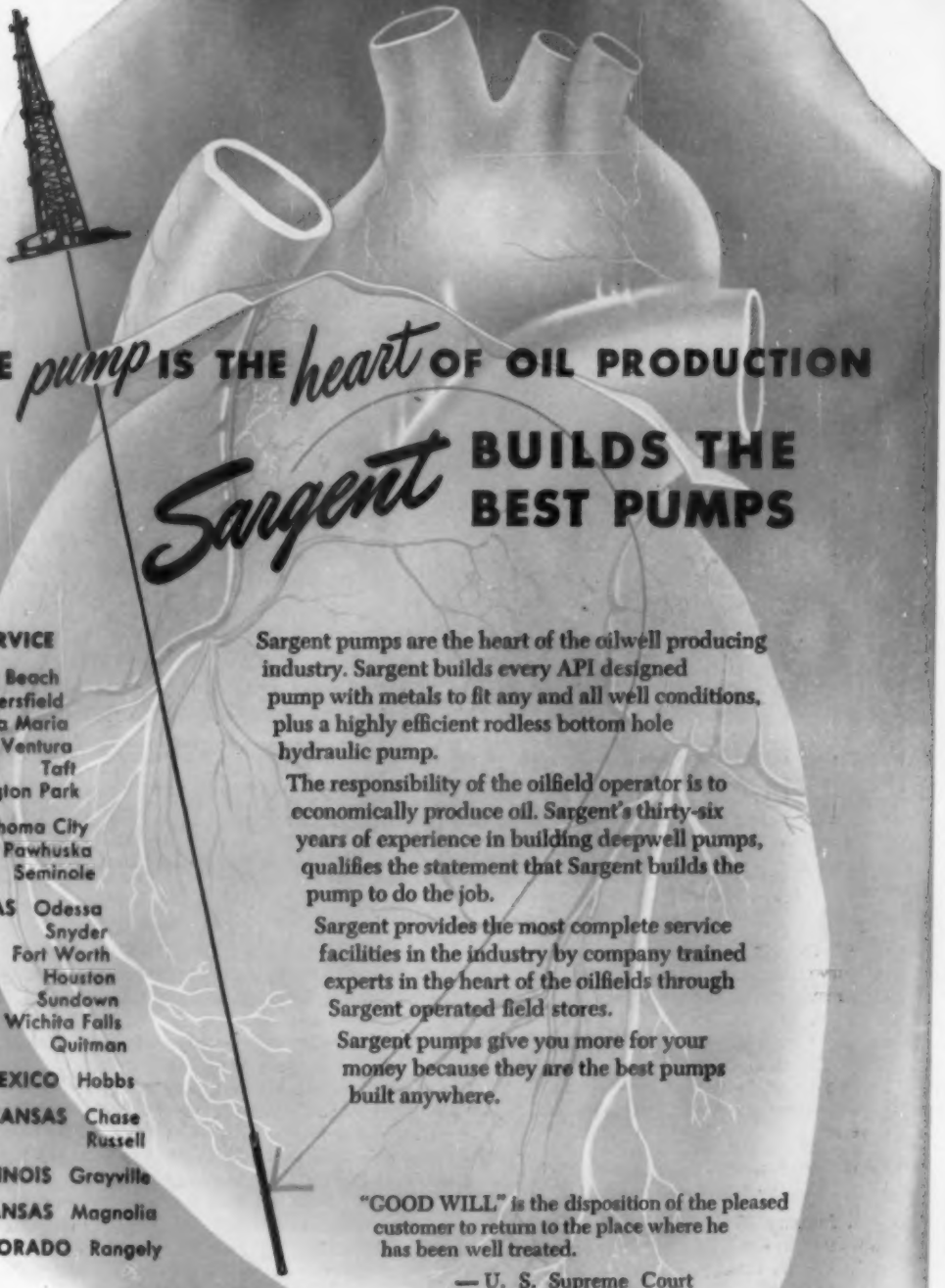
This conclusion is subject to serious question, particularly with respect to the soundness of the method employed to predict oil recovery at the assured high rate of water injection. First, only 1 year of actual field history was available for prediction at the high injection rate, and, from this small amount of data, a 6-year extrapolation was made.

To predict the ultimate oil recovery, the applicant extrapolated the production-decline trend along a curve concave upward, despite the expressed opinion that "... a straight-line decline curve on semilog paper ... is customary for water floods." Had the oil-rate curve been extended as a straight line with the initial slope of the rate curve, the predicted oil recovery would have been substantially less than that actually obtained under the flood operation.

Semilog plot... There is no sound basis, however, for assuming any particular shape for the curve obtained by plotting the logarithm of the oil production rate vs. time. In this flood, the decline in oil production rate occurred after water breakthrough and the subsequent history of oil production is related to the characteristics of the reservoir, the mobility of the fluids, and the rate of water injection. As pointed out previously, Yuster[13] concluded that:

> "... the semilogarithmic method of extrapolating is not mathematically exact for all cases and may not be used as evidence for losses during curtailment."

Cumulative-fluid plot . . . Since the plot of cumulative oil produced vs. cumulative water injected is a more revealing index of the effectiveness of a flood, the actual and the extrapolated data from Fig. 42 have been replotted in this manner in Fig. 43. Under the predicted performance, injection of a total of 5.2 million barrels of water at a constant high injection rate for 7½ years would have resulted in a recovery of 370,000 bbl. of oil. Under reduced rates of water injection, the actual cumulative oil production amounted to 344,000 bbl. after only 3.7 million barrels of water had been injected, and the flood was still producing 800 bbl. per month.



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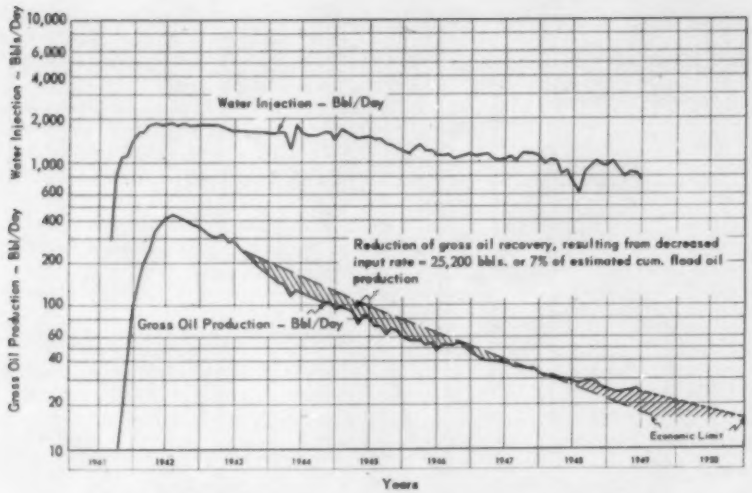
Water Injection – Bbl/Day
Gross Oil Production – Bbl/Day
Reduction of gross oil recovery, resulting from decreased input rate = 25,200 bbls. or 7% of estimated cum. flood oil production
Economic Limit
Years

Fig. 42—Exhibit 1 (1) as submitted by Forest Oil Corp.

Contrary to the claim that 7 per cent of the ultimate oil recovery would be lost because of reduced rates of water injection, the predicted oil recovery at the high injection rate and the actual oil recovery under reduced rates are very nearly the same for equal volumes of water injected. The contention that a reduction in rate of water injection resulted in a loss in ultimate oil recovery appears to be completely unfounded.

Among several investigators who have reviewed the behavior of this flood, Joers, et al,[24] (1950) described it as a very successful flood. Compared with other projects it had recovered more oil from the area. The effectiveness of this flooding operation contradicts the claim made in the South Ward hearing that the ultimate recovery was impaired by reduction in the injection rate.

Lynde, Walter, and Darby Lease "A," Neosho County, Kansas

Fig. 44 shows the history of another water flood in eastern Kansas submitted by Forest Oil Corp. at the South Ward hearing in January 1950, as evidence that a loss in ultimate oil recovery occurred as a result of a 2-week shutdown early in 1939. These data, offered as Exhibit I-2, are identical in every detail to the production and injection history of the Lynde, Walter, and Darby Lease "A" flood, Neosho County, Kansas[23 24] which has been described by Lawry,[23] and Joers, Grandone, and Taliaferro.[24]

The applicant projected the oil-decline rate occurring during the first year of operation (prior to the 2-week general shutdown) as a straight-line extrapolation until early 1942 when the flood was converted from pumping to flowing. The subsequent extrapolation of the oil recovery rate that would have occurred at continued high water-injection rates was a straight-line semilogarithmic projection having a different and arbitrary slope to the point of final abandonment. Based on a comparison between the predicted oil decline curve with the oil-production history actually observed, Forest concluded that reduced water-injection and oil-production rates during and subsequent to the 2-week shutdown resulted in a loss of 15 per cent of the ultimate oil recovery by water flooding.

Extrapolation questionable . . . Here again, a very short time period at the beginning of the flood was used as a basis for an extended extrapolation of the oil-rate curve. Further, the straight-line extrapolation was based on a period during which the water-injection rates were far from constant. The slope of the extrapolated curve between 1942, when the flood was converted to flowing, and 1946, the date of economic abandonment, is such as to render any quantitative estimate of the recovery under assumed high rate conditions questionable.

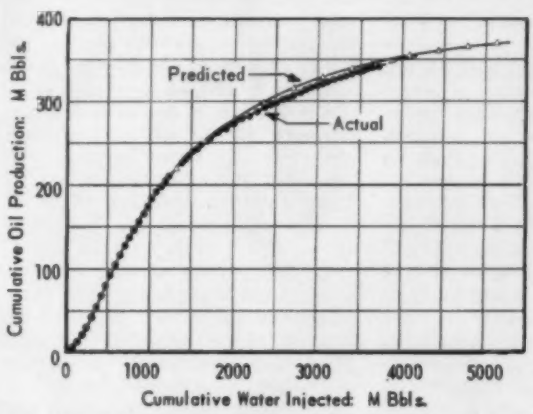

Fig. 43—Relation between oil production and water injection for a typical water flood (data replotted from Exhibit (1) submitted by Forest Oil Corp.)

The objections previously raised to this method of plotting and interpreting flood behavior assume greater importance in the case of this flood because of erratic changes in rate. To provide a more suitable analysis of the effectiveness of this flood and to determine whether or not the marked variations in rate of injection and rate of production actually exerted any

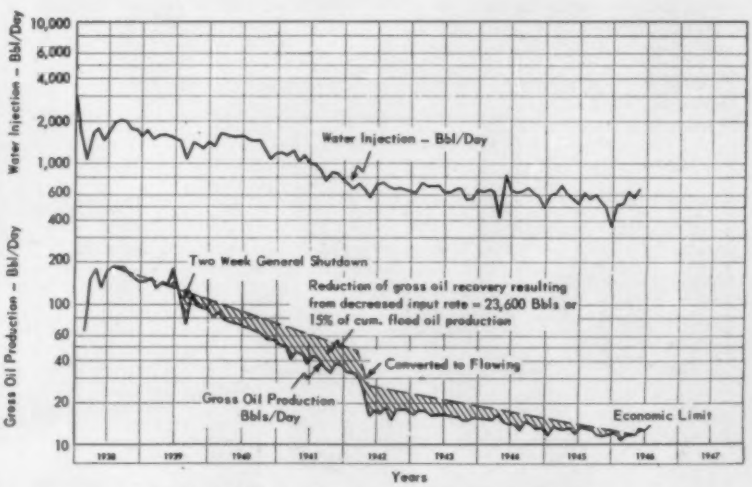
Water Injection – Bbl/Day
Gross Oil Production – Bbl/Day
Two Week General Shutdown
Reduction of gross oil recovery resulting from decreased input rate = 23,600 Bbls or 15% of cum. flood oil production
Converted to Flowing
Gross Oil Production Bbls/Day
Economic Limit
Years

Fig. 44—Exhibit 1 (2) as submitted by Forest Oil Corp.

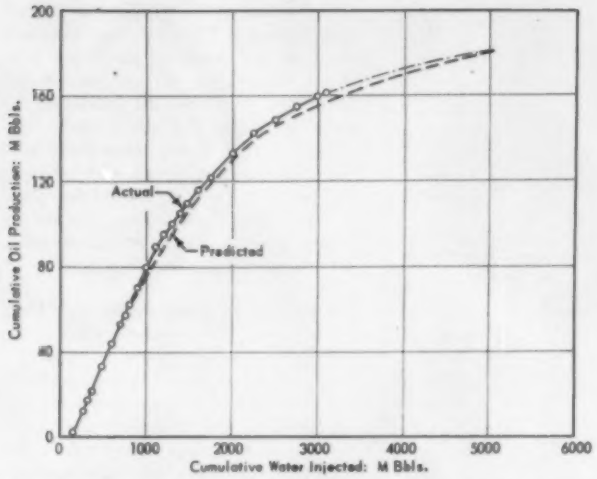

Fig. 45—Relation between oil production and water injection for a typical water flood (data replotted from Exhibit 1 (2) submitted by Forest Oil Corp.).

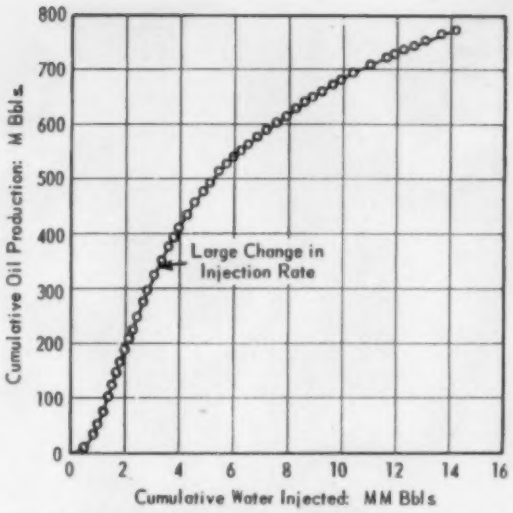

Fig. 47—Relation between oil production and water injection for a typical water flood (data replotted from Exhibit 1 (3) submitted by Forest Oil Corp.).

significant influence on the ultimate oil recovery, a plot of cumulative oil vs. cumulative water injected has been prepared (Fig. 45).

Comparison between production obtained under reduced rates of water injection and that predicted under continued high rates of injection shows no difference in magnitude or trend. The actual and predicted cumulative oil productions are very nearly identical at any particular cumulative volume of water injected. Ultimate oil recovery at either the high or low rate of water injection would have been the same.

Lawry[23] described the production history of this particular flood (see Fig. 12) as typical of many floods which had been converted to flowing after the economic life by pumping had been reached. He said that this flood reached a 30-bbl. per day economic limit by pumping early in 1942 because of high water volumes being handled. He further pointed out that upon conversion to flowing, the oil production rate declined sharply, but it was possible to continue profitable operation by flowing for 4 more years at a slower rate of decline and at considerably reduced and relatively constant rates of water injection. He concluded that continuation of the flood past the economic limit by pumping resulted in the recovery of an additional 21,000 bbl. of oil.

Contrary to the opinion expressed in the South Ward hearing, the aforementioned authors[23 24] considered this flood a highly successful operation. Lawry and Joers, et al., pointed out the benefits to be derived from conversion to a flowing flood and concluded that reduction in rate of production did not result in any loss of ultimate oil recovery. Rather, they concluded that a greater ultimate recovery would be obtained from the flood by flowing than by pumping because the reduced operating cost would result in a longer economic life. The analysis presented in Fig. 45 and the conclusions drawn by Lawry and by Joers, et al., demonstrate that the reduction in ultimate oil recovery alleged by Forest to have resulted from the reduced injection and production rates is unsupported.

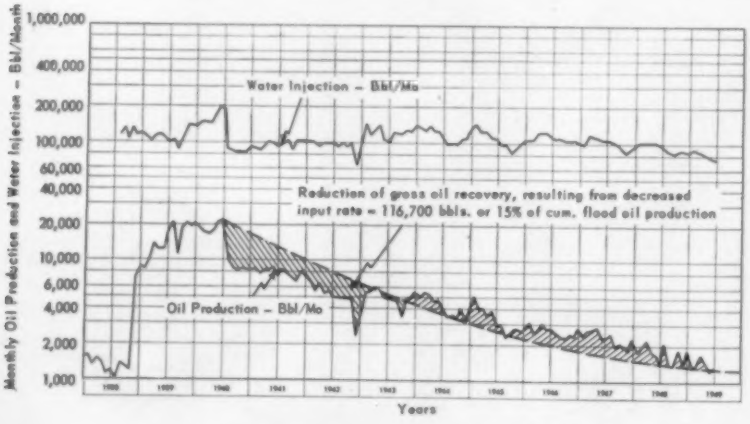
Monthly Oil Production and Water Injection – Bbl/Month
Water Injection – Bbl/Mo
Reduction of gross oil recovery, resulting from decreased input rate = 116,700 bbls. or 15% of cum. flood oil production
Oil Production – Bbl/Mo
Years

Fig. 46—Exhibit 1 (3) as submitted by Forest Oil Corp.

Water Flood in Northeastern Oklahoma

As further evidence that reduction in water injection and oil production rates causes a loss in ultimate oil production by water flooding, Forest submitted data on a water flood in northeastern Oklahoma in the South Ward hearing (Exhibit I-3, Fig. 46 this report). In mid-1940, approximately 2 years after the initiation of the flood, the rate of water injection was drastically reduced and sustained at a low level for the following 2½ years. According to Forest's interpretation of a production decline trend that might have prevailed had the initial high rates of injection been continued, this curtailment resulted in a 15 per cent loss in ultimate oil recovery.

Inasmuch as there had been no decline in oil-production rate at the early high injection rates, there is no basis for the extrapolation offered in this exhibit nor for the associated claim of the substantial loss in ultimate oil. The behavior of this flood has been analyzed by plotting cumulative oil produced vs. the cumulative water injected (Fig. 47). No evidence can be observed that the pronounced reduction in water injection rate affected the normal trend of the relation

between the cumulative oil produced and the cumulative water injected.

Comparison of the cumulative oil recovery for the actual operation with that predicted under assumed continuation of high injection rates indicates essentially no difference at comparable periods in the flood history. The claim that a 15 per cent loss in recoverable oil resulted from curtailed injection rates and from attendant reduced production rates is unwarranted.

Olympic Pool Flood, Oklahoma

Another hearing before the Railroad Commission of Texas in which restriction of water-flood production was claimed to reduce recovery is that of Ambassador Oil Corp. early in 1956 in which it requested capacity allowables for its flood in Kermit field, Texas. Cited as evidence in support of this position was the performance of water-flood operations in Olympic pool, Oklahoma. Production in this pool was curtailed by order of the Oklahoma Corporation Commission during June and July 1954.

In behalf of Ambassador Oil Corp. a technical witness submitted data covering only a very limited portion of the flood's history (circles in Fig. 48). A difference in slopes of the logarithmic decline in oil production rate versus logarithm of the time prior to and following the curtailment period led him to predict a loss in oil recovery. As pointed out previously,[13] the extrapolation of decline curves plotted as log-log or semilog functions of time to show losses in ultimate recovery is without basis and can lead to erroneous interpretation of flood behavior.

Examination of the entire history of this flood (see Fig. 48) instead of the limited period surrounding this minor restriction in oil production shows this flood reached its peak production in late 1953 and began a normal decline accompanied by steadily increasing water-oil ratios. During the 5 months prior to the curtailment period, the water injection rate was gradually reduced by about 10 per cent to an average rate of around 70,000 bbl. per day during mid-1954. As a result of this reduction in water injection rate and because of the enforced proration, the oil production rate also declined about 10 per cent. Subsequent fluctuations of the oil production rate decline also followed generally the variations in water injection rate.

To determine whether or not restriction in rate of production influenced the ultimate oil recovery, we examined the data in Fig. 49 showing the relations between cumulative

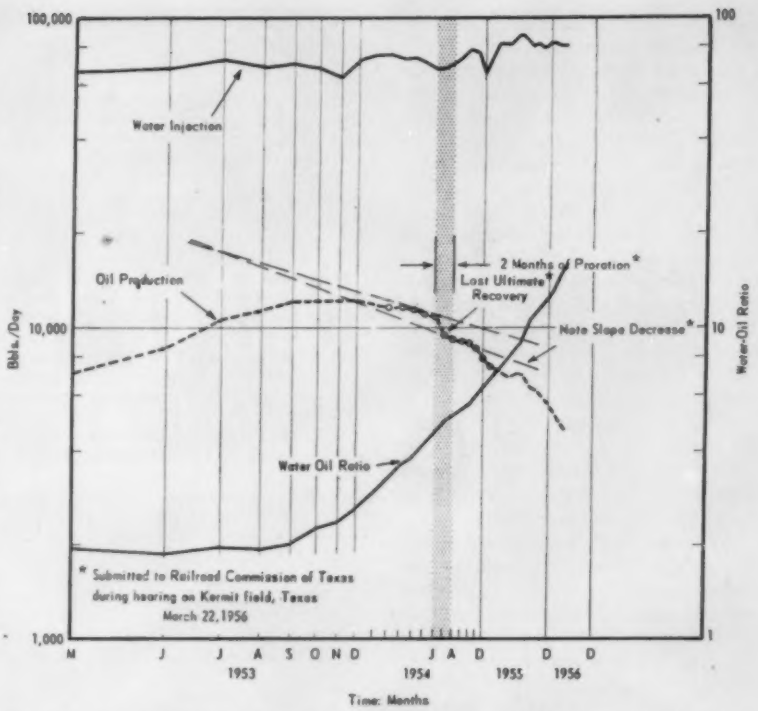

Fig. 48—Oil production and water-injection history for Buffalo Oil Co. water-flood project, Olympic pool, Oklahoma.

water injection and cumulative oil production, total fluid production, and water-oil ratio. The period of artificial restriction of production during June and July 1954 is indicated.

The cumulative total fluid production increased at a fairly constant rate with cumulative water injected, and no marked deviations occurred in the trend of the cumulative oil curve following the curtailment period. The absence of any anomalous behavior in either the cumulative total fluid or oil production trends as a result of restriction contradicts the claim that loss of recoverable oil occurred following curtailment.

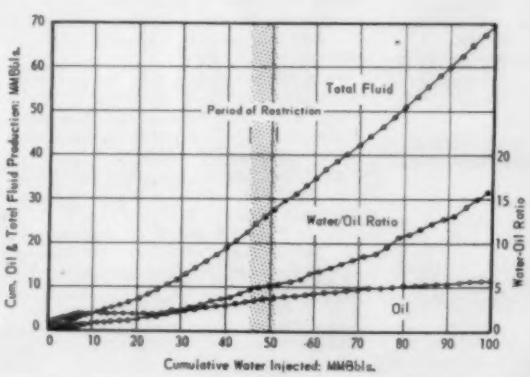

Fig. 49—Production history for Buffalo Oil Co. water-flood project, Olympic pool, Oklahoma.

Conclusions

In summary, our examination of the evidence supporting requests for unlimited allowables for water-flood properties reveals that claims of loss in oil recovery alleged to occur as a result of restriction in water injection or oil production rates are without foundation. On the basis of our analyses, supported by published conclusions of others who have also studied certain of these same floods, we conclude that no oil was lost in any of these operations because of reduced rates of injection or production.

Claims have also been made that in formations of variable permeability reduction in rate of water injection results in bypassing large quantities of oil in tight sands and, conversely, high injection rates promote high oil recovery. We have presented laboratory and theoretical evidence that such claims violate the fundamental physical principles underlying the mechanism of flow and displacement within heterogeneous sands.

In water-wet formations comprising layered noncommunicating strata of differing permeability, relative rates of fluid movement are proportional to the permeabilities of strata and would not be altered by a change in the injection pressure. In formations made up of tight sections in communication with or embedded in more permeable sections, reduction in rate of water advance allows capillary forces to come more into play with the result that the tight sections are permitted time to imbibe water and to expel oil into the more permeable portions before the water front advances beyond the tight section. Hence, reduction in rate of water advance does not result in loss of oil through bypassing, but can result in a more nearly uniform flooding of the formation, thereby increasing ultimate oil recovery.

With the field experience, theory, and laboratory experimentation presented in this report as a foundation, we conclude that high injection rates with unrestricted or capacity production are not necessary to obtain maximum oil recovery. Further, we conclude that **over the range of rates normally encountered in the field** the ultimate oil recovery from secondary water floods is not adversely affected by restriction in rate. Curtailment of the rate of production will not reduce ultimate recovery. In fact, in natural reservoirs comprising heterogeneous sands with intercommunicating lenses or strata where capillary effects are significant, reduction in rate of flood advance will probably enhance oil recovery.

References

1. I.O.C.C. Quarterly Bulletin, Vol. XIII, No. 2, 34, (1954).

2. Secondary Recovery of Oil in United States, A.P.I. (1950).

3. Standards of Allocation of Oil Production Within Pools and Among Pools, A.P.I. Publication (1942).

4. S. E. Buckley (ed.), Petroleum Conservation, A.I.M.E. (1951), pp. 151, 188.

5. M. Muskat, "The Effect of Permeability Stratification in Complete Water-Drive Systems," Trans. A.I.M.E., 189, 349.

6. P. Grandone, D. A. Jessup, and D. B. Taliaferro, "History of Water Flooding of Oil Sands in North Texas," B.M.R.I. 3906, U. S. Dept. of Interior (1946).

7. George H. Fancher, A.P.I. Secondary Recovery of Oil in the United States (1950), p. 175.

8. J. S. Aronofsky, "Mobility Ratio—Its Influence in Flood Patterns During Water Encroachment," Trans. A.I.M.E., 195, 15.

9. A. B. Dyes, B. H. Caudle, and R. A. Erickson, "Oil Production After Breakthrough—As Influenced by Mobility Ratio," Trans. A.I.M.E., 201, 81.

10. F. F. Craig, Jr., T. M. Geffen, and R. A. Morse, "Oil Recovery Performance of Pattern Gas or Water Injection Operations from Model Tests," Trans. A.I.M.E. (1955), 204, 7.

11. W. Hurst, "The Determination of Performance Curve in Five-Spot Water Flood," Paper 127-G, Oct. 1951, Petr. Branch, A.I.M.E.

12. J. P. Powell and K. H. Johnson, "A Survey of Oil Production in Oklahoma by Water Flooding, Part I, Nowata, Rogers and Craig Counties," B.M.R.I. 4831, U. S. Dept. of Interior (1952).

13. S. T. Yuster, "Technological Aspects of Water Flood Curtailment," Oil Weekly, Parts 1 and 2, Aug. 29, 1938, and Sept. 5, 1938.

14. Charles R. Fettke, "The Bradford Oil Field, Pennsylvania and New York," Pennsylvania Geological Survey, Fourth Series, Bulletin M 21 (1938).

15. A. B. Dyes and P. H. Braun, "Sweep-out Patterns in Depleted and in Stratified Reservoirs," (A.I.M.E. meeting, Wichita Falls, Nov. 17-18, 1954).

16. J. D. Walters, "Prolific Water Flood in East Kansas," The Oil and Gas Journal, May 4, 1953, p. 96.

17. R. C. Earlougher, "Relationship Between Velocity, Oil Saturation, and Flooding Efficiency," Trans. A.I.M.E. (1943), 151, 125.

18. R. C. Earlougher and Ray W. Amstutz, Preprint A.I.M.E., Secondary Recovery Symposium, Wichita Falls, Tex., Nov. 17-18, 1954.

19. Paul D. Torrey, "Operation of Water Flood Properties Under Proration Schedules," Natl. Petr. News, Nov. 12, 1930, p. 175.

20. T. F. Lawry, "Flowing vs. Pumping Operations on Water Production," (A.P.I. spring meeting, Mid-Continent District, May 1943).

21. R. C. Earlougher, "Flowing Production vs. Pumping Production," Oil Weekly, Aug. 26, 1946, p. 38.

22. D. B. Taliaferro, "Some Results of Secondary-Recovery Operations and Related Problems," Producers Monthly, April 1948, p. 22.

23. T. F. Lawry, "Flowing Water Flood Production," A.P.I. Secondary Recovery of Oil in the United States (1950), p. 311.

24. John C. Joers, Peter Grandone, and D. B. Taliaferro, "Water Flooding in the Humboldt-Chanute Oil Field, Neosho and Allen Counties, Kansas," Producers Monthly, June 1950, p. 12.

25. "Panel Discussion of Kansas-Oklahoma Secondary Recovery Problems," Producers Monthly, Jan. 1949, p. 14.

26. M. Muskat, "Physical Principles of Oil Production," McGraw-Hill, New York (1949), pp. 704-705.

27. O. K. Kimbler and B. H. Caudle, "An Enlargement Technique for the Semi-microscopic Study of Fluid Flow and Phase Distributions in Porous Media," (Paper No. 21. A.I.Ch.E. meeting, Houston, May 3, 1955).

28. T. F. Moore and R. L. Slobod, "Displacement of Oil by Water-Effect of Wettability, Rate, and Viscosity on Recovery," (Paper No. 502-G, A.I.M.E. meeting, New Orleans, October 2-5, 1955).

29. J. C. Calhoun, Jr., and J. W. LaRue, "The Effect of Velocity in Water Flooding," Producers Monthly, April 1951, p. 21.

30. J. Freeland and J. C. Calhoun, Jr., "A Survey of Laboratory Oil-Recovery Tests," Producers Monthly, September 1952, p. 29.

31. J. Newcombe, J. McGhee, and M. J. Rzaza, "Wettability versus Displacement in Water Flooding in Unconsolidated Sand Columns," Paper No. 511-G, A.I.M.E. meeting, New Orleans (Oct. 2-5, 1955), Trans. A.I.M.E., 204, 227 (1956).

32. R. O. Leach, T. M. Geffen, and V. J. Berry, Discussion of A.I.M.E. Paper 511-G, "Wettability versus Displacement in Water Flooding in Unconsolidated Sand Columns," presented during discussion of Paper 511-G, A.I.M.E. meeting, New Orleans (Oct. 2-5, 1955), published J. Petroleum Tech., March 1956.

33. G. H. Fancher, "Theoretical Considerations Involved in Secondary-Recovery Operations," Secondary Recovery of Oil in the United States, A.P.I. (1950), p. 178.

34. J. C. Calhoun, Jr., "A Discussion of the Effect of Pressure Gradients on Oil Recovery by Water Flooding," Producers Monthly, May 1951, p. 18ff.

35. B. H. Caudle, R. L. Slobod, and E. R. Brownscombe, "Further Developments in the Laboratory Determination of Relative Permeability," Trans. A.I.M.E. (1951), 192, 145.

36. T. M. Geffen, W. W. Owens, D. R. Parrish, and R. A. Morse, "Experimental Investigation of Factors Affecting Laboratory Relative Permeability Measurements," Trans. A.I.M.E. (1951), 192, 99.

37. J. S. Osoba, J. G. Richardson, J. K. Kerver, J. A. Hafford, and P. M. Blair, "Laboratory Measurements of Relative Permeability," Trans. A.I.M.E. (1951), 192, 47.

38. J. G. Richardson, J. K. Kerver, J. A. Hafford, and J. S. Osoba, "Laboratory Determination of Relative Permeability," Trans. A.I.M.E. (1952), 195, 187.

39. S. E. Buckley and M. C. Leverett, "Mechanism of Fluid Displacement in Sands," Trans. A.I.M.E. (1942), 146, 149.

40. L. A. Rapoport and W. J. Leas, Properties of Linear Water Floods," Trans. A.I.M.E. (1953), 198, 139.

41. C. R. Holmgren, "Some Results of Gas and Water Drives on a Long Core," Trans. A.I.M.E. (1949), 179, 103.

42. C. R. Holmgren, and R. A. Morse, "Effect of Free Gas Saturation on Oil Recovery by Water Flooding," Trans. A.I.M.E. (1951), 192, 135.

43. J. Saxon, J. N. Breston, and R. M. MacFarlane, "Increased Oil Recovery from Long Core Water Floods by Preliminary Gas Injection," Producers Monthly, January 1951, p. 7ff.

44. H. Dykstra and R. L. Parsons, "The Prediction of Oil Recovery by Water Flood," A.P.I. Secondary Recovery of Oil in the United States (1950), p. 160ff.

45. J. R. Kyte, R. J. Stanclift, S. C. Stephan, and L. A. Rapoport, "Mechanism of Water Flooding in the Presence of Free Gas," Jour. of Petr. Tech. (1956), 7 (9) 60ff.

46. D. M. Bass and P. B. Crawford, "Experimental Waterflooding Recoveries Above and Below the Bubble Point," Jour. of Petr. Tech. (1956), 8 (1) 45ff.

47. M. C. Leverett, W. B. Lewis, and M. E. True, "Dimensional-Model Studies of Oil-Field Behavior," Trans. A.I.M.E. (1942), 146, 217.

48. M. Muskat, "Physical Principles of Oil Production," McGraw-Hill, New York (1949), p. 13.

49. Paul D. Torrey, "Secondary Recovery of Petroleum," Producers Monthly, Sept. 1949, p. 18.

50. Harry M. Ryder, "Effects of Increase of Water Pressure on Water-Flooding Oil Production," Producers Monthly, XI (7), 18, May 1947.

51. John F. Buckwalter, "Selection of Pressure for Water Flooding Various Reservoirs," A.P.I. Drilling and Production Practice (1951), p. 257.

52. E. T. Heck and J. C. Vaughn, "Field Results from Increased Flooding Pressures," A.P.I. Drilling and Production Practice (1951), p. 280.

53. John C. Calhoun, "A Discussion of the Effects of Pressure Gradients on Oil Recovery by Water Flooding," The Oil and Gas Journal, 50 (27) 323, Nov. 8, 1951.

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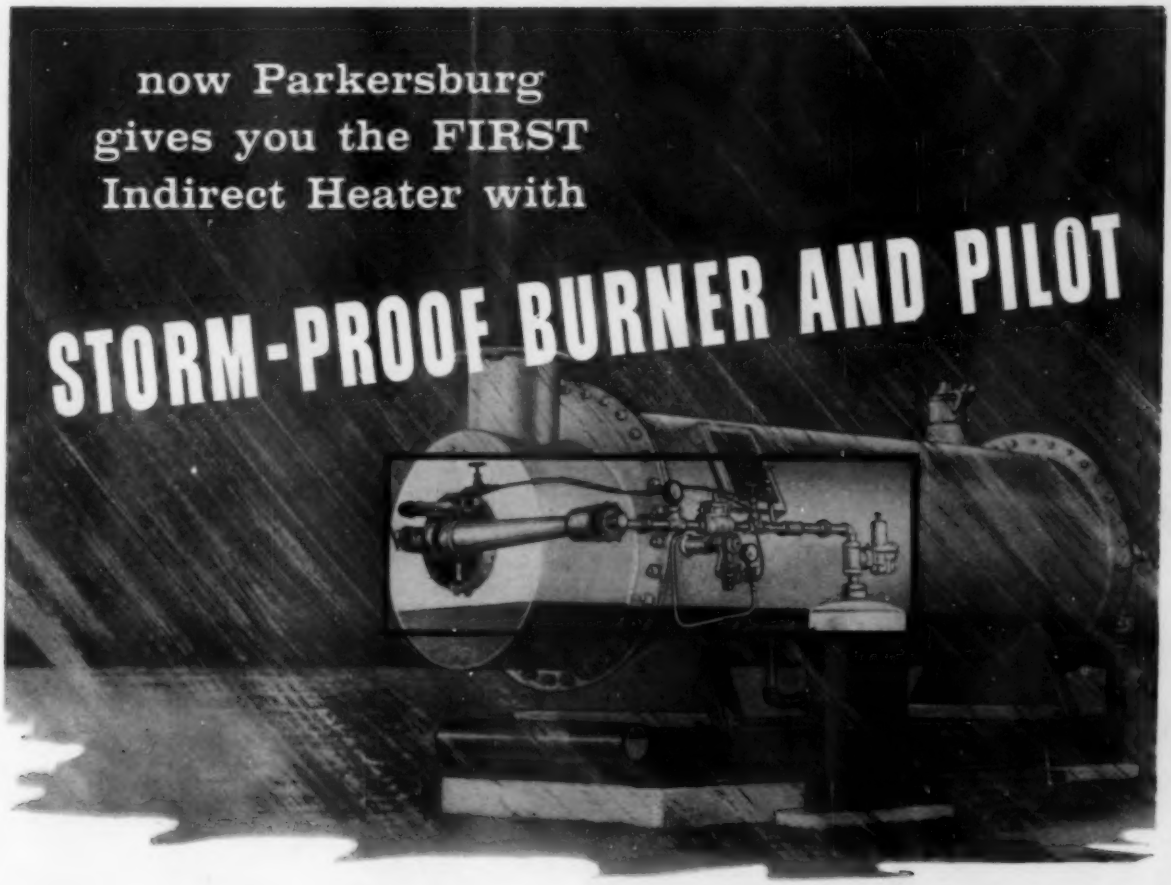

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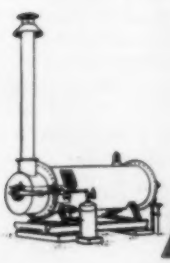

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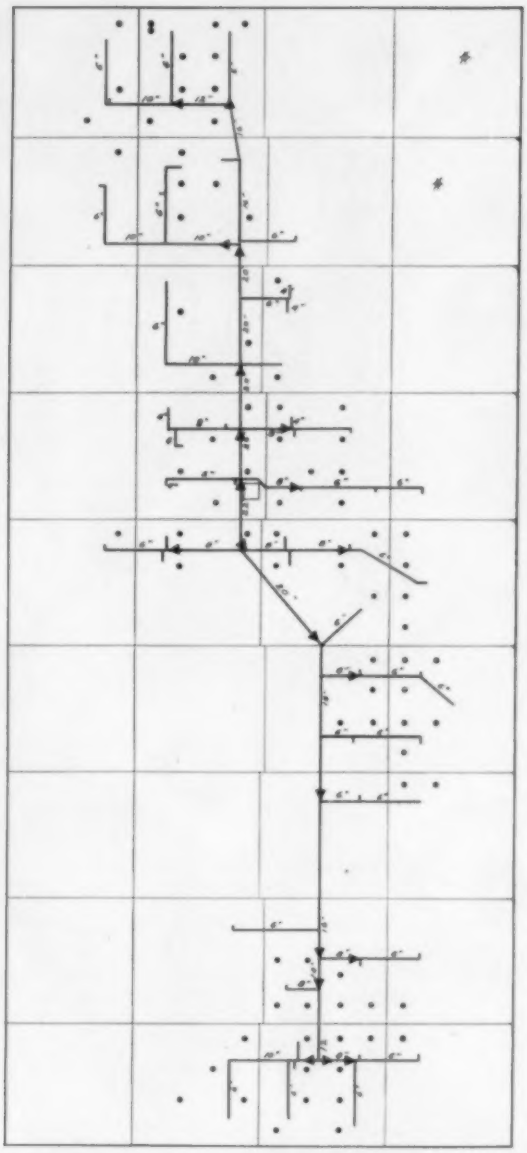

. . . complex 30-mile gas-gathering system with some 35 segments to serve the sprawling Roberts Ranch field of West Texas.

Gas-Gathering-System Design Is a "Natural" for The Electronic Computer

by A. E. Hass and J. B. Benear
Cities Service Oil Co.

CITIES SERVICE OIL CO. recently designed the gas-gathering system for Roberts Ranch gasoline plant in Midland County, Texas, with an electronic computer. This is a joint-interest project owned by leaseholders of the Roberts Ranch area.

The advantages of a computer in solving this design problem are:

. . . Computations requiring days on a desk calculator are made in a matter of minutes.

. . . It's more accurate.

. . . Engineers are released from

routine, time-consuming calculations for more productive work.

... A computer makes it relatively simple to design a number of systems with different initial and terminal pressures and to compare the economics of each.

The company has had the computer for about 2 years and the personnel who direct the machine's operations are constantly on the lookout for new computer applications. The design of a gas-gathering system is a natural for the electronic computer because of the multitude of times the same operation must be performed to solve the problem. A computer has been described as having the equivalent of a low degree of intelligence and tremendous speeds to perform logical and arithmetic operations, whereas man has a very high degree of intelligence and is relatively slow at solving arithmetic operations. Once the computer and the engineer have a common language, which is accomplished by the programing of an operation, they make a powerful team by which complicated problems may be rapidly solved.

Formula, design data . . . The Weymouth formula for the flow of gas through pipelines was used for the design of this gas-gathering system.

$$P_2^2 = P_1^2 - (Q/K)^2 L \qquad (1)$$

where

P_1 = initial pressure, psia.
P_2 = outlet pressure, psia.
L = length of line in miles
Q = quantity of gas, cu. ft. per day
d = inside diameter of pipe, in.
$K = 810.504\ d^{2.67}$

The design group is furnished the following information concerning a proposed system:

1. Location of wells, separators, delivery point, etc.
2. Rate of gas flow, its flowing temperature, specific gravity, and pressure base.
3. Initial pressure.
4. Terminal pressure.

Sizing the line . . . After the wells, separators, and compressor site have been spotted on a map, the gathering lines are laid out. With the above information given and the proposed routing of the system laid out on a map, these steps are followed to size the line: First the average allowable pressure drop per mile is computed. From this point the manual steps below are adaptable to the electronic computer. Each segment is sized in succession starting at the terminal point and working out to the end of each branch.

The application of the formula is a method of trial and error. The initial pressure, P_1, length of line, L, and the rate of gas flow, Q, are known quantities and a guess is made to select a diameter. The corresponding K for the selected diameter corrected for specific gravity, temperature, pressure base, and compressibility where applicable is determined. The formula is then solved for P_2. If P_2 is too large or too small a second trial is made selecting a different diameter. This procedure is continued until a pressure P_2 is found which most nearly compares with the desired P_2.

This Roberts Ranch system consists of approximately 30 miles of trunk and branch lines with approximately 35 segments requiring the solution of the above equation many, many times. The magnitude of the problem and the time required to complete it manually becomes apparent when it is considered that all of the mathematical operations are performed on a desk calculator. And each time the equation is solved it is necessary to extract the square root. Also because each step depends on the last one, an error may nullify a large portion of the work. It would take approximately 5 days for one man to completely size the lines in a gathering system of this size with a calculator whereas on an electronic computer this operation is performed in a matter of minutes with faultless accuracy.

Programing . . . Programing or the adaptation of the manual method of solving the problem to the electronic computer required the greatest amount of time. The first step is to analyze the formula and simplify, if possible, in order to reduce the formula to the four basic arithmetic operations. The course of action of the computer is planned and the logical sequence of steps is set forth on a planning chart. From the planning chart the control panels are wired. These panels set the machine's operations. One panel controls the arithmetic operations, the second panel controls the card reading and punching operations. Before the problem is run, it is necessary to program test the machine. This checks the accuracy of the control-panel wiring. Meanwhile, four different types of cards are being prepared:

1. The initial read-in card which is key punched with the required pressure at the plant or initial point of a branch.

2. The header cards which are key punched with the controlling information for each leg. This card specifically contains:

(a) The assumed terminal pressure squared. Calculations were performed in terms of the squares of pressures, rather than in terms of the pressures expressed linearly to avoid any necessity of taking square roots.

(b) Length of the segment.

(c) The estimated maximum rate of flow through that segment.

3. The detail cards consisting of one card for each size of pipe which might be used are key punched and reproduced once for each leg of the pipeline system. These cards contain information as to the K constant depending upon the size of pipe and additional information as to the cost of laying the pipe.

4. The answer card which as its name implies receives the answer or the selected diameter, the computed terminal pressure, and the cost of laying that leg of the system.

The cards representing the primary pipeline are formed by placing cards or decks in order starting at the plant and proceeding outward in this order:

1. Place initial read-in card, representing plant pressure, first.
2. Place header card representing first leg.
3. Place detail deck.
4. Place answer card.
5. Place header card representing next leg.
6. Place detail deck.
7. Place answer card.
8. Repeat procedure.

The cards are then processed through the computer. The square of the plant pressure is read from the initial read-in card and the information stored in the computer. The square of the estimated terminal pressure, Q and L, are read from the header card and the following expression is solved in terms of K and stored for reference:

$$P_1^2 - P_2^2 = L_1 Q_1^2 / K_1^2 \qquad (2)$$

From following detail cards, beginning with the one representing the largest pipe size, is read the K value representing that pipe size. The stored value of K is subtracted from the read value of K and the counter tested for a negative balance.

A negative balance denotes a pipe size too small and the previously tested pipe size is too large. The negative balance causes two things to occur in the computer:

1. The transfer of a selector (switch change) causing K, pipe size, and cost per foot to be read from the previously tested card (next larger size) and stored as it passes a second reading station.

2. The suppression of any further calculation until a code punch is read

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from the answer card at a second reading station.

When this condition occurs the computer recalculates Equation 2, this time in terms of P_2 and with a specific value of K producing the exact value for P_2 resulting from the selected pipe size. This result is stored. Also calculated and stored is the cost of the segment which is the extension of cost per foot and L. When the answer card passes the punching station, the results are punched.

The value of P_2 is retained in its storage unit available for the calculation of the next segment of the system.

The process is continuous and the whole main line may be handled at the cyclic rate of 100 cards per minute. Answer cards may be used as initial read-in cards for branches feeding the main line. However, to maintain clarity of identification it is advisable to reproduce pertinent columns of answer cards into other cards bearing branch identification.

Sorting and collating may be done by machine. Manual collating is usually satisfactory except for large systems with many branches.

Assuming a main line of 20 segments and including 12 pipe sizes in each segment (this number may be reduced) the solution of the main line will take $20\,(12+2)/100 = 2.8$ minutes.

Computer advantages . . . The application of the computer solution to gas-gathering systems makes it more feasible to further investigate the initial and terminal pressures in a system. It is relatively simple to design a number of systems with different initial and terminal pressures and compare the economics of each gathering system with the resultant compressor and separator requirements. The programing of any particular system is adaptable to any other gas-gathering system. By retaining the wired control panels and key punching new initial read-in cards, header cards, and answer cards any gas-gathering system may be evaluated.

Construction details . . . This system has been placed in operation. Gathering-system construction is quite different from trunk-line construction in a number of ways. The two most outstanding differences are the large number of pipe sizes involved and the large number of fittings, meter runs, tieins, etc. Because of pressures involved in operating this system, a large amount of money was saved through the use of thin-wall pipe.

Pipe sizes ranged from 4-in. through 26-in. and wall thickness ranged from 0.1046 in. to 0.1644 in. The 4, 6, and 8-in. pipe was in 40-ft. lengths and all other sizes were 50-ft. lengths. On pipe having 0.1046-in. through 0.1345-in. wall it was decided to use a bell-and-spigot joint and use a shear type of weld instead of the common butt weld used on plain-end pipe. The width of weld metal on the spigot end was specified to be 1.5 times the thickness of the pipe wall. This has worked very satisfactorily by using three beads in the welding process. The 0.1644-in. wall pipe was beveled for welding and the regular butt weld was used.

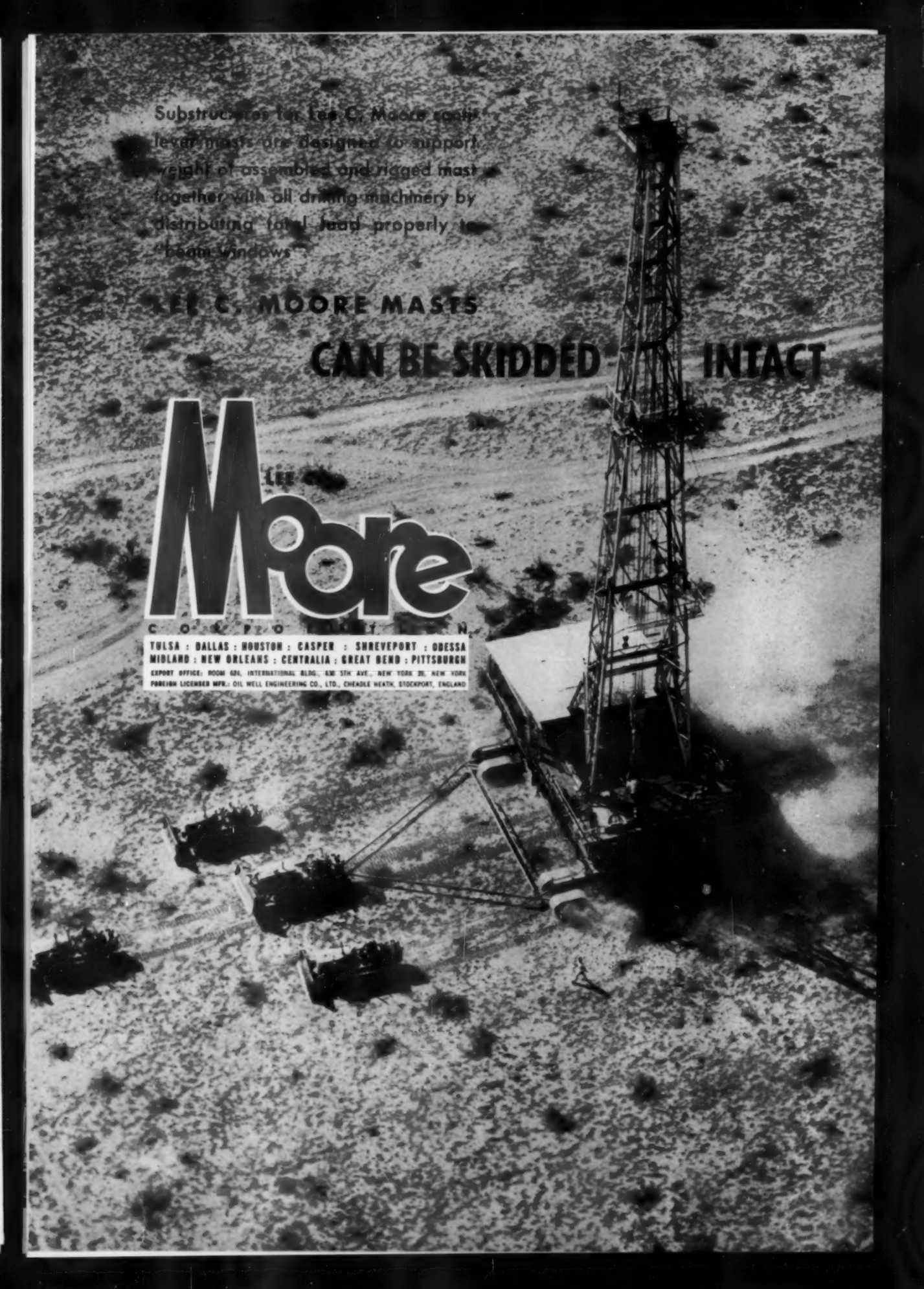
Pipe was yard coated, using primer, enamel, glass inner wrap, and kraft outer wrap. Field joints were coated manually after welding.

The larger sizes of pipe were spiral-weld pipe but due to the nature of the terrain, very few bends were required. Where large bends were required in the large pipe, weld ells were used. Where small bends were required on the bell-and-spigot pipe, these were accomplished at the joints. It was possible to get several degrees of deflection at the bell-and-spigot joint without hampering welding procedure on the joint.

The system is insulated at each connection to the producers' flare line through the use of insulating unions and then each trunk line is insulated at the plant entrance with insulating gaskets and sleeves at flanges. It is intended to apply cathodic protection to the system in the near future. Installation of insulating materials now will simplify this work.

Butterfly valves . . . Another interesting feature was the use of butterfly valves throughout this system, both in the main lines and laterals. These valves were also used on meter runs. This is a very simple valve and affords a positive shutoff. It has an oil-resistant lining or seat that also eliminates the need for gaskets between gate body and flanges. The gate body fits inside the flange-bolt circle, which requires slightly longer bolts but requires only one set per valve installation.

Another advantage to this valve is the ease with which it may be removed from the line. Bolts on the bottom half need only be loosened and only those on the top half need be removed in order to slip the entire valve from between the flanges. All of the valves are manually operated, the small sizes having an operating handle which needs only to be moved through a 90° arc to open or close the valve. The two 20-in. valves in the system have worm-gear mechanisms with handwheel operation. **End.**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Use of D.S.T. Data in Determining Reservoir Performance

As for instance . . .

- Average formation permeability within drainage area of well.
- Well-bore damage or skin effect.
- Initial reservoir pressure.
- Open-flow potential of the well.

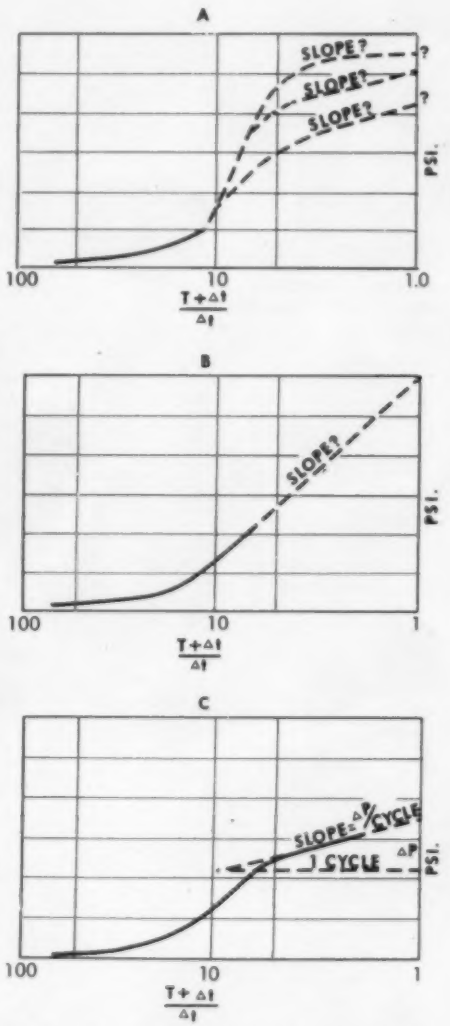
by Albin J. Zak, Jr., and Phil Griffin III

DRILL-STEM-TEST data can be used in determining three very important elements of reservoir performance: (1) average formation permeability within the drainage area of the well; (2) well-bore damage or skin effect, and (3) initial reservoir pressure. A fourth element, open-flow potential of the well, is predicted through the use of fluid-recovery data obtained during the open-flow portion of the drill-stem test.

The key to any pressure-buildup analysis is sufficient shut-in time for the pressure-buildup curve to reach the straight-line portion and allowing it enough time to obtain an accurate value of its slope and to allow proper extrapolation to reservoir pressure. Quite often in the case of drill-stem tests, the shut-in period is not long enough to have allowed pressure build-up in the producing interval to reach the straight-line portion of the curve. Consequently, the drill-stem test is rendered useless from a quantitative point of view.

How long a test? . . . Just how long the shut-in period of a drill-stem test should be depends on the open-flow time, degree of well-bore damage, formation permeability, and the pressure-volume-temperature characteristics of the reservoir fluid. However, based on observations made during evaluation of several hundred pressure-buildup tests, a shut-in time at least equal to, if not greater than, the open-flow time is required before the straight-line portion of the pressure-buildup curve is attained and sustained.

In many cases the straight-line portion was reached at shut-in time as



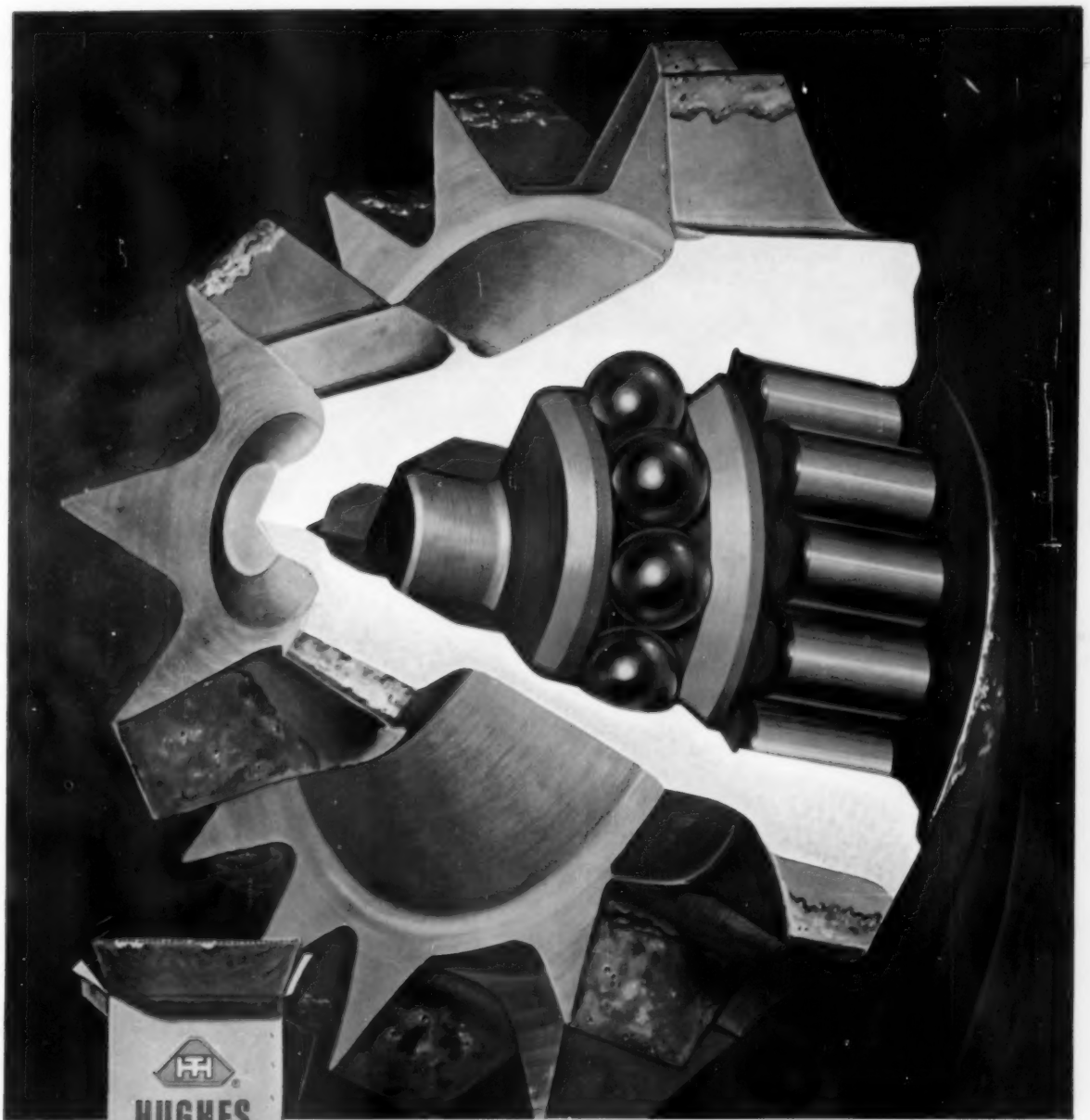
Buildup curve resulting from entirely too short a shut-in time. There is no indication of the curve having reached its straight-line position.

The same buildup curve if allowed added shut-in time. Note the development of an apparent straight-line portion of the curve.

Buildup curve if allowed sufficient time to reach true straight-line portion. Note error introduced by using apparent straight-line portion.

PRESSURE-BUILDUP PLOTS showing varying degrees of development of pressure-buildup curves. Fig. 8.

DRILLING



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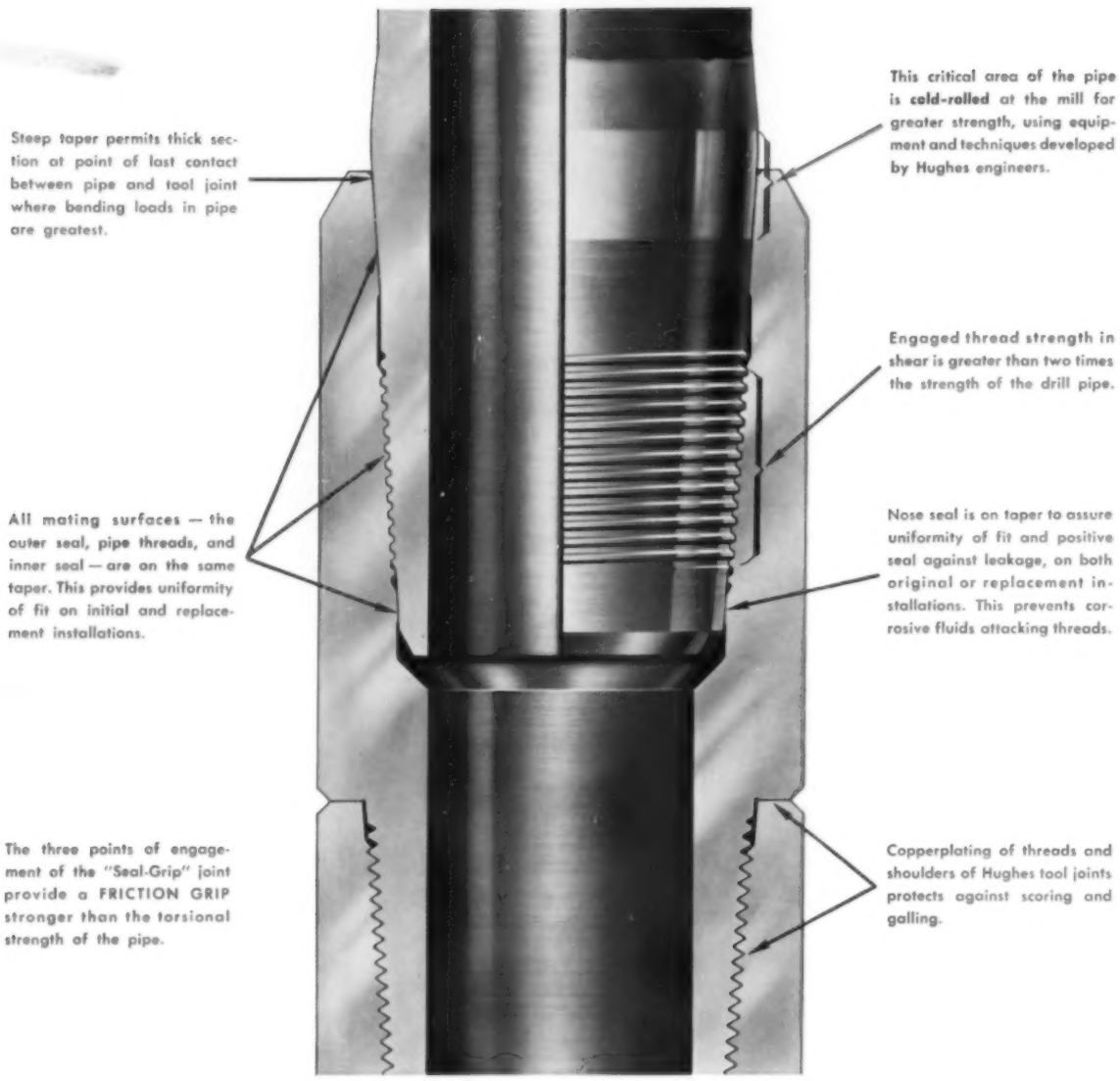
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low as one-half the open-flow time, but in no instance was there any buildup curve that had not reached the straight-line portion by a shut-in time equal to the open-flow time. In the majority of situations an open-flow time of 1 hour followed by a 45-minute to 1-hour shut-in period is recommended.

Excluding extreme reservoir situations, this procedure would yield a sufficient buildup curve. Since so many factors enter into the determination of sufficient shut-in time, it is also recommended that, if possible, drill-stem-test records from wells tested in the same locality and in the same stratigraphic interval be consulted as to what ratio of open-flow time to shut-in time should be used.

Being assured of a sufficient shut-in time to reach the straight-line portion of the buildup curve means the difference between a useless test from a quantitative standpoint and a test which will yield valuable reservoir information. Of the tests examined by the authors, more than 40 per cent were useless from a quantitative standpoint because insufficient shut-in time was allowed.

Effect on curves . . . Fig. 8 shows varying degrees of development of a pressure-buildup curve. Fig. 8A depicts a buildup curve resulting from entirely too short a shut-in time. There is no indication of the curve having reached its straight-line portion.

Fig. 8B depicts the same pressure-buildup curve if allowed added shut-in time. Note the tendency for the development of an apparent straight-line portion of the curve. This apparent straight line is not the straight-line portion needed for slope determinations and curve extrapolation.

Fig. 8C shows the buildup curve if allowed sufficient shut-in time to reach its true, straight-line portion. It is readily seen that quite an appreciable error is introduced when using the apparent straight-line portion as shown in Fig. 8B. These curves point out an obvious advantage of some surface means of recording the subsurface pressure behavior during the drill-stem test.

Formation Permeability

There are several prerequisites to determining the average formation permeability from drill-stem-test data—the slope of the pressure-buildup curve, P.V.T. data on the reservoir fluid, and the fluid recovery as obtained during the open-flow period of the test. All of the factors must be accurately determined if reliable results are to be obtained. As previously discussed, Equation 1 (Part 1, April 15 issue), the slope equation, is used to calculate the formation permeability from drill-stem-test information.

TABLE 2—COMPARISON OF DRILL-STEM-TEST PERMEABILITY WITH CORE-ANALYSIS PERMEABILITY

Test interval	Lithology of tested interval	Core-analysis permeability	Drill stem-test permeabiilty	Remarks
1	Lime	2.0	2.7	Argillaceous in part
2	Lime	23.0	20.0	Few tight fractures
3	Lime	4.5	4.1	
4	Lime	0.6	0.2	
5	Lime	2.3	0	Incomplete core recovery
6	Lime	0	0.1	
7	Lime	0	2.8	Analysis of five core samples indicated zero permeability-perforated and swabbed 120 b.o.p.d. and 21 b.w.d.
8	Lime	0.65	0	
9	Sand	50	34	
10	Sand	0.7	189	Questionable slope; difference may also be due to presence of fractures
11	Sand	89	40	High-viscosity crude
12	Sand	69	53	
13	Sand	56	86	Well fractured to make producer; pumped 106 b.o.p.d.
14	Sand	41	8.9	P.V.T. data questionable
15	Sand	50	4.2	Core analysis based only on 10 ft. of pay; 30 ft. not cored. D.S.T. recovery indicates very low K. Well fractured and pumped 18 b.o.p.d. and 1 b.w.d. Abd. after prod. 5,800 bbl. oil
16	Sand	17	5.9	
17	Sand	0.1	0	
18	Sand	1.3	1.7	
19	Sand	157	182	Well fractured
20	Sand	1,900+	445	Fluid viscosity questionable
21	Sand	10	12	
22	Sand	40	47	

Compared to cores . . . Core-analysis permeability and drill-stem-test permeabilities are not the same. Core-analysis permeability is a homogeneous-fluid permeability measured usually with air on a dried core sample. No other fluids are present, and one core is used to represent the formation producing fluids into the well bore. On the other hand, a drill-stem-test permeability is an average formation permeability within the drainage area of the well. Its determination is based on oil recovery during the open-flow period of the test and hence may be considered as a relative permeability to oil or gas, depending on the fluid being produced.

Unlike core-analysis permeability, the drill-stem-test permeability is measured with other fluids present and flowing through the formation. Hence it will of necessity have a lower value than a core-analysis permeability on the same interval—assuming reservoir homogeneity.

In the case of a fractured reservoir or one composed of interconnected vugs and crevices, the drill-stem-test permeability could be greater, less than, or even equal to the core-analysis permeability, depending on how representative the core sample is. In a test interval of this nature, the use of the drill-stem test to predict formation permeability could be of great value since it is a measure of the average production capability of the formation and not of a small core sample comprising only a very minor portion of the reservoir.

Limitations . . . There are several limitations to the use of drill-stem-test data in determining formation permeability. They include:

1. Incomplete pressure-buildup data.
2. Lack of fluid-recovery information from test intervals having low permeability or exhibiting appreciable well-bore damage.
3. Inaccurate pressure measurements.
4. Improper buildup-curve extrapolation.
5. Incorrect P.V.T. data.
6. Absence of P.V.T. data on reservoir fluid in the case of a wildcat well.

Tests . . . Table 2 gives a comparison between permeabilities determined from drill-stem-test data and permeabilities determined from core analysis. Where reliable core data, fluid P.V.T. data, and pressure-buildup data were available, the values of permeability compare quite favorably.

Major disagreement between results occurred only in cases where the slope

of the buildup curve or the P.V.T. data were questionable, or the core analysis of the test interval was incomplete. This disagreement occurred in test intervals 10, 14, 15, and 20.

In the case of test interval 15, the drill-stem-test permeability may be closer to the true permeability than that reported by core analysis. Even after hydraulic fracturing of the well, the resulting production rate points more nearly to a 4-md. producing interval than a 50-md. producing interval as the well pumped only 18 bbl. of oil daily and 1 bbl. of water daily after treatment.

As a whole, the results indicate that the use of drill-stem-test data can provide reliable permeability information in some cases, but in others, due to unknowns or incomplete buildup, may be unreliable. The use of drill-stem-test data is not intended to replace any other method of permeability determination and is presented only as another possible tool to aid in determining the true reservoir permeability. For top efficiency, the drill-stem-test method should be used in connection with electric logs, bit cuttings, and cores in evaluating the reservoir characteristics.

Well-Bore Damage

The determination of well-bore damage from drill-stem-test data can provide valuable reservoir information very early in the life of the well. Use of the drill-stem test in this manner will supplement information obtained from core analyses and electric logs, thereby providing one more tool to aid in evaluation of a petroleum reservoir.

A question arises in connection with evaluating low-capacity producing intervals as to just why the well is unable to produce. Quite often, wells exhibiting appreciable formation permeabilities will show low productivity with the sole reason being that of well-bore damage.

Estimating well-bore damage before completion of the well, therefore, will definitely aid not only in selecting the proper completion technique but also in evaluating low-productivity wells.

Data needed . . . Determining well-bore damage from drill-stem-test data necessitates having adequate pressure-buildup data, core-analysis data, and the reservoir fluid P.V.T. data as required by Equation 3 (Part 1).

Perhaps the greatest limitation to using drill-stem-test data in computing well-bore damage is not having complete reservoir-rock and fluid data available at the time the test is made. Even when good pressure-buildup data are obtained, the test is useless for computing well-bore damage unless complete reservoir rock and fluid data are available.

An empirical method of determining well-bore damage will be presented in Part 4 which utilizes only pressure-buildup data and eliminates the need for P.V.T. data and core-analysis data. In this manner, well-bore damage can be computed almost immediately after the drill-stem test is made.

TABLE 3—COMPARISON OF WELL-BORE DAMAGE IN SAND AND LIMESTONE FORMATIONS

Formation—	Sand	Limestone
Tensleep	—0.27	....
First Dakota	—1.34	....
Granite Wash	—2.37	....
Davis	1.80	....
Simpson	....	15.44
Mission Canyon (frac.)	....	10.3
Cordell	8.14	....
Devonian (Massive)	....	—1.66
Charles (frac.)	....	12.0
J sand	—3.4	....
Embar	....	—2.59
Embar	....	54.54
Madison	....	71.88
Madison	....	3.2
Amsden	....	5.15
Amsden	....	0.8
Phosphoria (Tensleep)	0	....
Dakota	4.0	....
Mississippi (frac.)	....	9.0
Mississippian (frac.)	....	19.0
Mission Canyon (frac.)	....	220.0
Sub-Clarksville	0	....
Paluxy	1.0	....
Wilcox (Texas)	2.1	....
Potlatch anhydrite (frac.)	....	12.0
Potlatch anhydrite (frac.)	....	100.0
Rundle (frac.)	....	35.0
Canyon	4.4	....
Muddy	0	....
Paluxy	0.6	....
Little	2.0	....
Tensleep	2.5	....
Pennsylvanian	4.6	....
Paluxy	0	....
First Dakota	—0.46	....

Nature of damage . . . Well-bore damage may be thought of physically as a zone of reduced permeability adjacent to the well bore. This permeability reduction imposes an added pressure drop near the well bore over and beyond the pressure drawdown of the producing interval.

This added pressure drop is principally responsible for the S-shaped pressure-buildup curve obtained from some drill-stem tests. This added pressure drop also reduces a well's capacity to produce.

Permeability reduction adjacent to the well bore can be created in several ways. Among these are:

1. Swelling of formation clays by invasion of mud filtrate.
2. Invasion of mud solids into the rock interstices.
3. Creation of a water block due to wettability properties of the reservoir rock.
4. Creation of a gas block due to excessive gas coming out of solution as caused by pressure drop near the well bore.
5. Actual physical damage to the reservoir rock brought about by drilling the well.

There has been a great deal of discussion as to just what factors predominate in causing well-bore damage. One opinion is that the swelling of formation clays is the chief factor causing well-bore damage and that only sands with a bentonitic clay content would exhibit any type of damage. Clean sands and limestones would therefore never show damage.

Another opinion is that the invasion of mud solids or the presence of a water or gas block would cause well-bore damage in the sense that the permeability to oil is reduced. This could occur in all formations. Relatively new to well-damage considerations is realization that actual, physical damage to the rock is brought about by drilling the well.

Cases of damage . . . Table 3 was prepared to see to what extent the above listed factors are active in causing well-bore damage. The clean sands such as the Paluxy, J sand, First Dakota, etc., exhibited small amounts of well-bore damage. On the other hand, the sands usually found containing clays and classed as relatively "dirty" sands such as the Cordell, Canyon, Wilcox, etc., exhibited larger amounts of well-bore damage. All of the extremely high values of well-bore damage were measured where the producing interval was comprised of a limestone.

Another interesting thing is to note that not one stratigraphic unit exhibits the same relative degree of permeability reduction in all wells with exception of the Paluxy sand. This lack of uniformity in behavior could be easily explained in the case of sands because of their lateral variations in lithology.

On the other hand, it is difficult to visualize relatively uniform, lithologic units as the Madison or Embar lime having extreme variations in well-bore damage as shown in the table, unless in one instance the limestone is fractured and in the other instance the limestone is massive and has only matrix permeability. Then, variations in well-bore damage would be expected.

Fractured limestones would be subject to invasion of mud solids and finely broken bit cuttings. They would have a tendency in most cases to exhibit more damage than limestones with matrix permeability which are subject only to filtrate invasion. Fractured limestones would also be more

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TABLE 4—COMPARISON OF D.S.T. RATES AND OPEN-FLOW POTENTIALS

Well No.	Net section		D.S.T. data			Gage through perforations		Comparison by rates			
								D.S.T.		Potential	
	Logs	Cores	Time open (hours)	Bbl. per hour	G.O.R.	Bbl. per hour	G.O.R.	Bbl. per day	Bbl. per day-feet	Bbl. per day	Bbl. per day-feet
1	25	..	1½	23	....	95	6,020	550	22	2,270	91
2	6	6	3½	36	900	5.3	(?)	860	144	127	21
3	9	16	1½	53	1,500	27	1,460	1,270	141	650	72
4	20	..	½	29	4,600	19	7,650	695	35	455	23
5	25	..	1	90	1,060	30	1,200	2,140	53	720	18
6	24	..	1¼	40	1,420	50	1,400	960	40	2,000	83
7	17	..	1½	48	3,900	25	5,600	1,150	67	600	35
8	35	..	1	66	1,140	20	1,830	1,580	45	480	14
9	15	..	1½	33	4,700	40	1,500	790	53	960	64

susceptible to actual crushing of the fracture walls adjoining the well bore which would tend to seal the fractures and cause a high degree of well-bore damage.

The data recorded in the table show this to the extent that practically all of the high well-bore-damage figures correspond to test intervals containing fractured carbonate rocks. Probably the low well-bore-damage figures correspond to test intervals containing carbonate rocks with matrix permeability. However, except for the Devonian lime tested, the data available are too meager to yield any conclusive proof.

Clay swelling, mud-solids invasion, and actual, physical formation damage are possibilities in each well drilled, regardless of the lithology of the formation encountered. However, the data point toward clay swelling as the major factor responsible for the development of well-bore damage in sandstone formations.

On the other hand, invasion of mud solids and actual, physical formation damage seem to be the major factors responsible for the development of well-bore damage in limestone formations. The presence of a water block and gas block are not impossible by any means, but in the case of a drill-stem test with its small flow period their presence is highly improbable.

Initial Reservoir Pressure

The reservoir pressure obtained from the drill-stem test is undoubtedly closer to the initial pressure of the virgin reservoir than any subsequently measured reservoir pressures. Whether determined from the "initial shut-in" pressure data taken before the formation has been allowed to produce or from extrapolation of the pressure-buildup curve obtained after the well has been allowed to produce, never again can the reservoir pressure be determined at so near the virgin state of the reservoir.

It is recommended that an initial shut-in pressure[6] be determined. In this manner there will be assurance of obtaining the original reservoir pressure in event that too short a shut-in time does not permit obtaining enough pressure buildup to enable extrapolation to reservoir pressure.

Data were not available for comparing initial reservoir pressure as determined from drill-stem-test data with initial reservoir pressures determined from bottom-hole-pressure surveys made shortly after completing the well. Since both cases use the pressure-buildup method of extrapolation in determining the reservoir pressure, it is very doubtful that the drill-stem-test pressure would be unreliable unless inaccurate pressure data were obtained.

In previous years, accuracy of drill-stem-test pressure recorders was questionable. But pressure-recording devices are now available which are capable of 0.1 per cent accuracy at 10,000 psi. even under conditions of severe shock to the pressure recorder.

Open-Flow Potential

In order to predict the open-flow potential, true volume (s) of the fluids produced during the tested interval are needed. Determination of the true volume (s) produced is complicated by:

1. Presence of drilling mud in the fluid recovery.
2. Inability to determine exact fluid fillup with a "heading" column.
3. Mixtures of oil, gas, formation water, filtrate water, and mud.

A small amount of drilling mud will be present on almost every drill-stem test. The volume of mud recovered should equal the total volume of mud below the packer, at hydrostatic mud pressure, plus 5 to 10 per cent of this volume, which will allow for mud expansion when the hydrostatic pressure is reduced to the initial flow pressure. Accurate records should be kept of the mud level at the surface and for any unnatural drop in this level the corresponding volume of mud should be added to the recovery.

Subtracting total estimated mud volume below the packer and in the drill pipe from the total fluid fillup volume yields the true volume of fluid produced by the formation tested.

Measuring fluid . . . Drill-stem-test recoveries are normally measured in the number of feet of oil, oil-cut mud, and/or salt water in the pipe which is far from the most accurate method of determining a fluid volume. Reverse circulating the fluid recovery into a test tank is recommended for total volume determination.

Low fluid volumes present the problem of intermixed recoveries. The following rule of thumb is generally applied:

1. Slightly oil-cut mud contains 25 per cent oil by volume.
2. Oil-cut mud contains 50 per cent oil by volume.
3. Heavy oil-cut mud contains 75 per cent oil by volume.

The above is also true of gas or water recoveries. Centrifuge tests of a suite of samples will yield much more accurate results.

Black[7] presented a method of determining that the waters recovered were formation waters or filtrate waters. Such a method should be investigated as large amounts of filtrate water are often recovered.

In the majority of cases the flow potential of a drill-stem test will not correlate with the flow potential of the completed well. Table 4 shows some examples. This is attributed to several items:

1. Tested interval not the same as completed well-producing interval.
2. Subsequent artificial stimulation of the completed well-producing interval.
3. Partially plugged casing perforations.
4. In cased holes, the flow is gaged through perforations and not open hole as is done on the drill-stem test.
5. Drill-stem test is conducted using bottom-hole chokes.

References

6. Johnston Testers, "Practical Manual," published 1955.
7. Black, Marshall W., "A Review of Drill-Stem-Test Techniques and Analysis," A.I.M.E. Formation Evaluation Symposium, October 1955, pp. 98-125.

BLITZING ALKYLATION PROBLEMS—4

Four Upkeep Problems Are Solved

by Larry Resen
District Editor

Many maintenance problems crop up in alkylation units. They seem to call for more than the usual ingenuity in determining the proper solutions. Here are some rather typical problems and how they were handled successfully.

Problem: Fouling of Reboilers

Solution: Use of dual reboilers.

Discussion: In operation of a reactor effluent distillation train, the reboilers on the debutanizer tower were subject to fouling out. The tower was operated at a fairly high temperature and the fouling was sufficient to cause unscheduled shutdowns.

In this particular unit, the debutanizer is the first tower in the train, rather than the deisobutanizer. In a unit revamp, the original debutanizer was converted to a second alkylate rerun tower. The new tower was sized to handle total distillation section charge. With this arrangement, deisobutanizer load was lessened and unit operations have been satisfactory.

The debutanizer is equipped with thermo-siphon type reboilers. These are normally connected in parallel (A in diagram). They have been equipped with valves on inlet and outlet lines to permit either to be isolated from the flow system. Each outlet line is equipped with a stub connection.

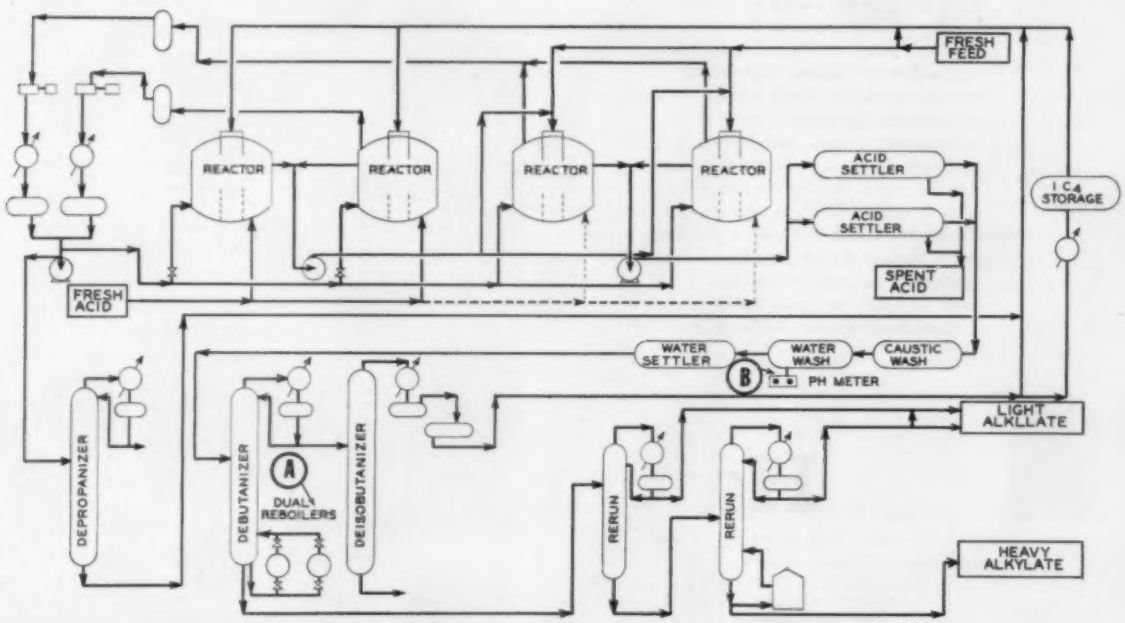
Under current operating conditions, about halfway through each run, the unit throughput is cut back, and one of the reboilers is isolated from the flow and cleaned. Cleaning takes place either by backwashing — tying into the outlet line stub with high-pressure water — or by pulling the bundle and washing it directly. Once the reboiler has been cleaned, it is placed back on stream and the other taken off and cleaned. In this manner it has been possible to eliminate unscheduled shutdowns due to reboiler plugging.

Problem: How to Detect Acid

Solution: Use of pH recorder on water-wash system.

Discussion: In the flow process, reactor effluent passes through acid settlers and then a caustic-wash system, including caustic-wash drum, water-wash drum, and water settler, before being charged to the distillation section. On various occasions during a startup, upset conditions on the reactor permitted acid to be carried over into the distillation system. Before the presence of acid was detected, serious damage had been done to the reboilers.

To prevent such occurrences, a recording pH meter was installed in the caustic-wash system (B in diagram). It continuously records a slipstream of spent water from the water-wash drum. Any time reactor upsets cause an excessive amount of acid to be carried over into the caustic-wash system, there will naturally be an increase in the acidity of this water. The pH meter records this increase immediately and at the same time



DOWN TIME due to fouling of reboilers was eliminated by using dual units. ACID DETECTION DIFFICULTIES on the same unit were solved by installing a pH recorder.

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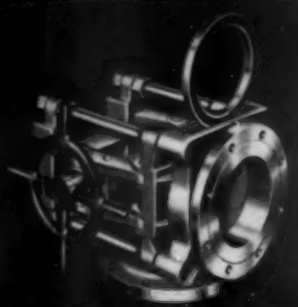

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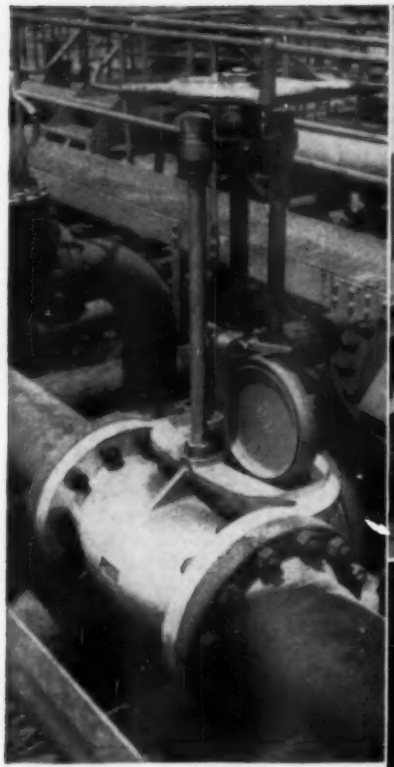

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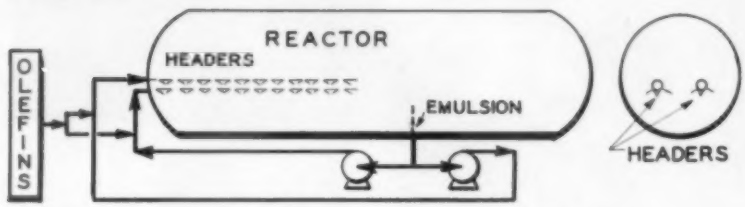
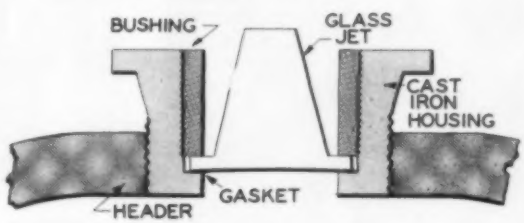
sounds an alarm. The operator can then proceed to correct the difficulty or reduce rates to keep acid away from the reboiler tube bundles.

The pH meter-alarm provides a supplementary service with regard to the caustic-circulating pump. This pump will occasionally come down of its own accord and thereby cut off caustic circulation in the wash system. With no caustic being circulated there is consequently no control over the acidity of the stream leaving the caustic-wash drum. The same condition would then exist—that of acid continuing on into the distillation section. However, the pH meter records spent-water acidity no matter what the cause and the alarm will sound as soon as the caustic pump kicks out.

Problem: Breakage of Glass Reactor Jets





CAST-IRON assembly units were installed in a horizontal jet-type reactor to hold the glass reactor jets. The cast-iron units are then screwed into headers.

Solution: Use cast-iron assembly units.

Discussion: In a horizontal jet-type reactor, emulsion is circulated into two headers along with olefin feed. The headers are long lengths of extra-heavy 10-in. pipe. Each has 128 threaded ports into which pyrex-glass jet assemblies were screwed.

Breakage of the glass jets and lack of a seal between jet assembly and header caused trouble. Most of this trouble was due to corrosion eating away the threads. The original jets included a tapered pyrex jet nozzle assembled in a steel retainer. This entire assembly would then be screwed into the header. Much of the breakage would result as the entire assembly was made up into the header.

Several high alloys were used in an attempt to improve the corrosion situation. Some of these were welded directly to the header, but a high rate of corrosion continued.

A change was made to cast-iron assemblies, and these were made up into the threaded ports on the headers. The result has been the elimination of thread-corrosion problems, such as experienced with the steel-glass assemblies.

Since using the cast-iron jet assemblies, it's been noticed that corrosion of the header is occurring away from the jetted area. The use of cast-iron headers is being contemplated in place of the steel headers, which should automatically take care of this corrosive situation.

Problem: Removal of "Rag" In Water Settler

Solution: Install baffle to provide separator drawoff section.

Discussion: Reactor effluent is normally treated for removal of acid prior to distillation. The stream first passes through a caustic wash and caustic settling drum. It is finally water-washed to remove sodium sulfate left in from the neutralization process.

A buildup of a "rag" interface took place in the water settling drum on one unit. Reactor effluent plus water is introduced to this drum and the washed effluent withdrawn overhead to the fractionation system and water pulled off the bottom. The rag is a process byproduct which is heavier than the effluent hydrocarbons and lighter than water. Over a period of time, this foreign material would build up to the point where it would carry over with the effluent. This caused fouling of downstream equipment.

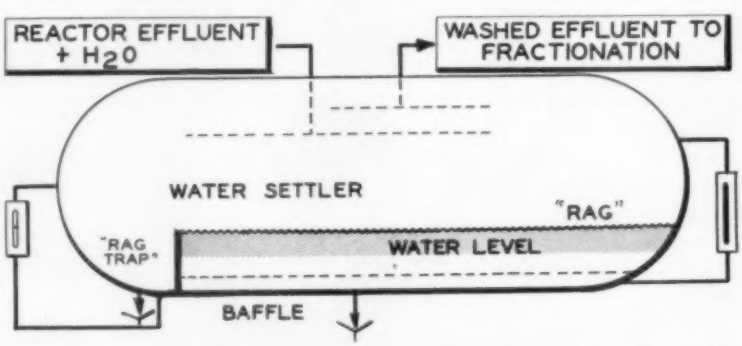
Efforts were made to pull out the rag through the water-drawoff line. This proved unsatisfactory. The water had to be pulled out first to get to the interface to pull it out and the attending upset of the tower feed system was too great.

A simple modification to the water-settling drum solved this problem. A baffle was put in near one end. This provided a trap into which the rag would spill and be drawn off. Water level in the drum is maintained so the interface is at about the same height as the baffle's top edge. With this in service, buildup of the interface is eliminated by periodically withdrawing all the water as well as the rag from the rag trap. The quantity of water removed when blowing the rag out is greatly reduced, therefore minimizing the fractionation-section feed reduction and attending upset.

Problem: Keeping Tube Bundles Clean

Solution: Periodically backwash with fire water.

Discussion: A considerable amount of condensing equipment is used in the fractionation section of an alkylation unit. At one particular plant, a soft sludge deposit was observed on the water side of the condenser tube bundles. It was decided to go to periodic backwashing to remove this sludge. In this way, heat transfer could be improved and unit run life could be extended.



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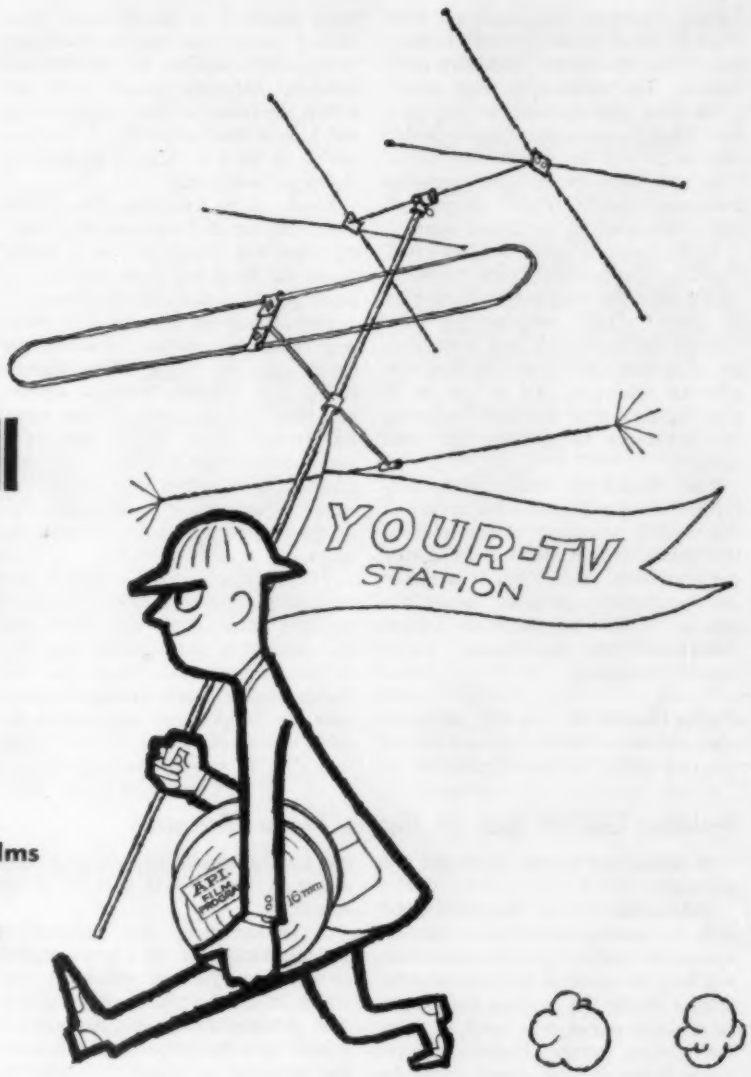

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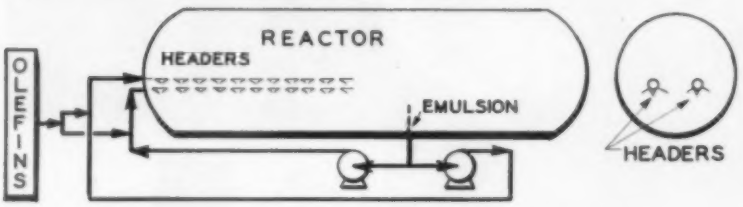

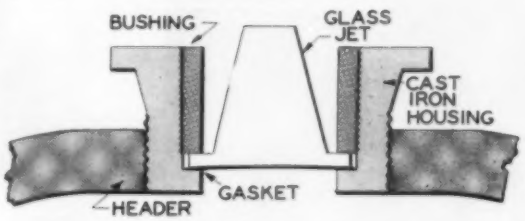

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Several high alloys were used in an attempt to improve the corrosion situation. Some of these were welded directly to the header, but a high rate of corrosion continued.

A change was made to cast-iron assemblies, and these were made up into the threaded ports on the headers. The result has been the elimination of thread-corrosion problems, such as experienced with the steel-glass assemblies.

Since using the cast-iron jet assemblies, it's been noticed that corrosion of the header is occurring away from the jetted area. The use of cast-iron headers is being contemplated in place of the steel headers, which should automatically take care of this corrosive situation.

Problem: Removal of "Rag" In Water Settler

Solution: Install baffle to provide separator drawoff section.

Discussion: Reactor effluent is normally treated for removal of acid prior to distillation. The stream first passes through a caustic wash and caustic settling drum. It is finally water-washed to remove sodium sulfate left in from the neutralization process.

A buildup of a "rag" interface took place in the water settling drum on one unit. Reactor effluent plus water is introduced to this drum and the washed effluent withdrawn overhead to the fractionation system and water pulled off the bottom. The rag is a process byproduct which is heavier than the effluent hydrocarbons and lighter than water. Over a period of time, this foreign material would build up to the point where it would carry over with the effluent. This caused fouling of downstream equipment.

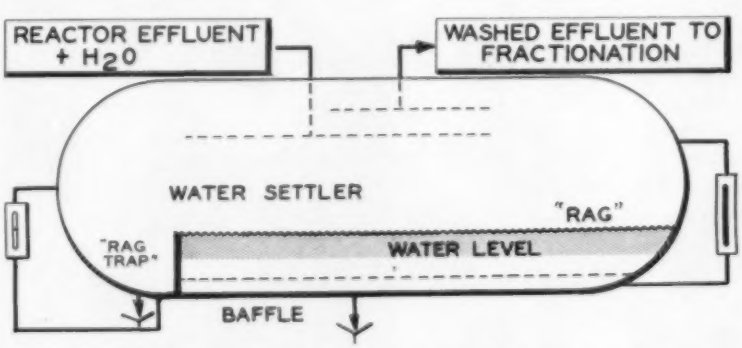
Efforts were made to pull out the rag through the water-drawoff line. This proved unsatisfactory. The water had to be pulled out first to get to the interface to pull it out and the attending upset of the tower feed system was too great.

A simple modification to the water-settling drum solved this problem. A baffle was put in near one end. This provided a trap into which the rag would spill and be drawn off. Water level in the drum is maintained so the interface is at about the same height as the baffle's top edge. With this in service, buildup of the interface is eliminated by periodically withdrawing all the water as well as the rag from the rag trap. The quantity of water removed when blowing the rag out is greatly reduced, therefore minimizing the fractionation-section feed reduction and attending upset.

Problem: Keeping Tube Bundles Clean

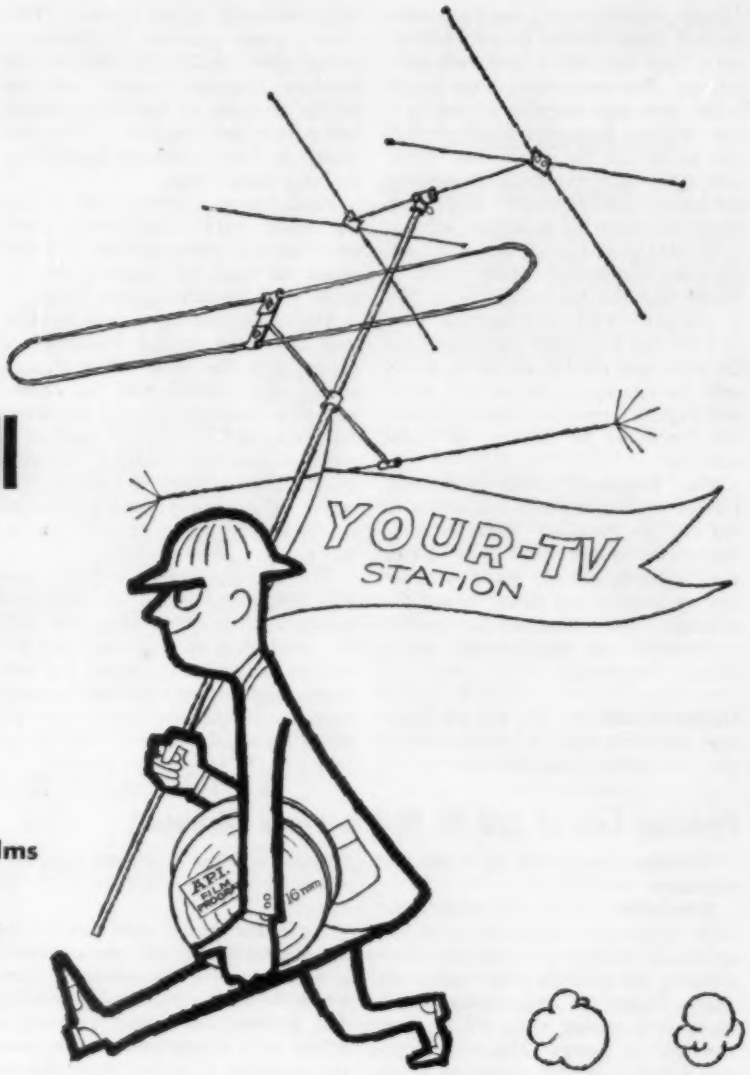
Solution: Periodically backwash with fire water.

Discussion: A considerable amount of condensing equipment is used in the fractionation section of an alkylation unit. At one particular plant, a soft sludge deposit was observed on the water side of the condenser tube bundles. It was decided to go to periodic backwashing to remove this sludge. In this way, heat transfer could be improved and unit run life could be extended.



A NEW BAFFLE was installed in this water settler to trap the "rag" without upsetting the rest of the system.

Now you can help tell oil's story on TV!



Bring "PROGRESS PARADE" films to your local TV station— build prestige for yourself and your industry!

The Oil Information Committee is producing a series of special TV programs about the oil industry called "PROGRESS PARADE." Each program takes the viewer "behind the scenes" to show him this vital industry is working in his best interests. All phases of the industry are covered—and because the programs are informational in nature, stations are glad to telecast them in the public interest—without commercials.

"PROGRESS PARADE" offers you an excellent opportunity to participate in your industry's public relations program and to tell your neighbors how petroleum helps make their everyday lives more enjoyable, more worthwhile.

The Program Manager of your local TV station is constantly looking for new program features and will be happy to receive these specially prepared 13½-minute films. Four different TV films are issued every year.

How to get "PROGRESS PARADE" television films

First check if the TV station in your community has the latest "PROGRESS PARADE" film. If not, just get in touch with your local Oil Information Committee. They will provide you with the most current "PROGRESS PARADE"—and any additional information you'll need.

Don't miss this opportunity to tell *your* story—the oil story—on television. You'll be helping yourself, your company and your industry all at the same time!

American Petroleum Institute
50 W. 50th St., New York 20, N. Y.

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NAME _____

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CITY _____ **ZONE** _____ **STATE** _____

Each condenser was equipped with isolating block valves in the cooling-water lines and with a backwash connection. The connections were usually the same pipe diameter or one pipe size smaller than the cooling-water line so as not to restrict the water flow and were located between the condenser cooling-water supply-line block valve and the condenser inlet.

To backwash a condenser, the cooling-water supply-line block valve is closed and the backwash connection is opened. This reverses the flow through the condenser and discharges the backwash directly on the unit slab near the condenser. Air at 110 psi. is also injected into the water entering the condenser to increase the tube velocity.

The backwash water not only flushes out the deposits but serves as the cooling medium. There is some fluctuation within the towers during the backwash period, but it is minor and temporary and hence is not too critical. The fractionation-section condensers are backwashed on a weekly frequency.

Chiller bundles . . . On this particular unit, ammonia chillers are used to cool the circulating emulsion prior to its being returned to the reactor. This cooling phase provides the necessary refrigeration required for efficient alkylation. Deposits would build up within the tubes of the chiller bundle and reduce their capacity. It was desirable to have a flushing system for cleaning these tubes.

Block valves were installed so that the chiller could be completely isolated. This was important for it eliminated the need for emptying the reactor prior to cleaning the tubes.

The chiller can be washed by shutting down the reactor, isolating the chiller with the block valves, depressuring and blinding only the chiller, and then flushing out with fire water on a reverse flow. In this case as in the fractionation section, 110-psi.-plant air was turned in with the fire water to provide a desired agitation of the water as it passed through the tubes.

The net result was to not only provide better cooling, but the increased refrigeration available with clean tubes has resulted in an improved acid life. In one extreme case, where the tube bundle had not been washed for some time, the temperature drop across the tubes decreased from a 30°-35° range to a 17°-18° range after washing.

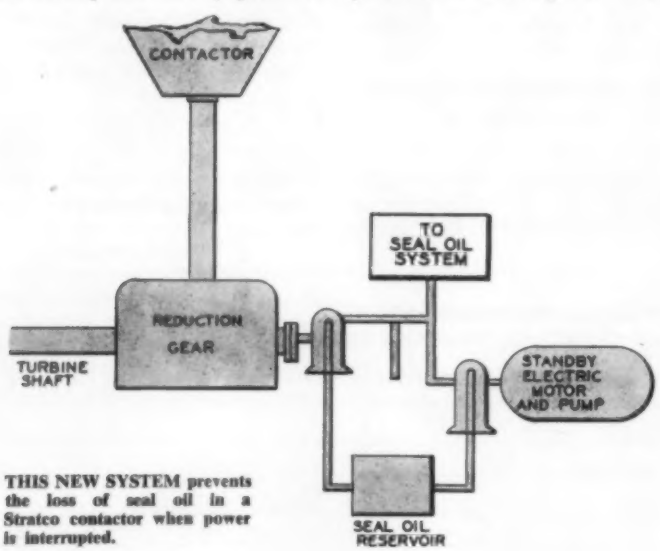
Problem: Loss of Seal Oil Due to Power Disruption

Solution: Use turbine drive and add auxiliary.

Discussion: In an alkylation unit with a Stratco contactor, a seal-oil system is used to prevent acid from reaching the seals on the reactor drive shaft. Under the original conditions, an electric motor was used to drive the seal-oil pump. However, occasional power failures would cause the motor to stop and thereby permitted the acid to intrude into the seal. This meant the seal would have to be renewed.

A second pump was installed on the seal-oil system. It was coupled to a shaft on the gear-reduction unit which drives the contactor's impeller. The gear-reduction unit, in turn, is driven by a steam turbine. Whenever the contactor is in operation, the impeller will be turning and hence the seal-oil pump will also be operating.

The original electric motor and pump, meanwhile, is now used as a startup and shutdown auxiliary. In this manner, the seal-oil system can be started up before the acid emulsion is being circulated and continued until after circulation has ceased. The turbine-driven pump, meanwhile, will take over once the turbine is up to speed, whereupon the electric motor is cut off until the unit is ready to be shut down. **End.**



THIS NEW SYSTEM prevents the loss of seal oil in a Stratco contactor when power is interrupted.

BOOKS

THE GEOLOGY OF THE OKMULGEE DISTRICT by David M. Logan. Published by the Okmulgee Geological and Engineering Society, Box 2341, Okmulgee, Okla. $5.

This presentation was given as an illustrated talk by Logan before the organization last year. It contains a description of all the surface and subsurface formations of the Okmulgee district and comments on the cross-sections and types of electric logs that are illustrated. Maps and plates are as large as can be shown on pages 8½ by 11 in.

PETROLEUM CARGOES by H. Hyams. Published by Brown, Son & Ferguson, Ltd., 52-58 Darnley Street, Glasgow. 379 pp. $7.50.

This book comprises nine chapters and 41 tables. Some general information is given on definitions, applications, and quality control of petroleum products; then follow details of the recommended standard procedures and apparatus to be used in measuring volumes and weights of tanker quantities. The 41 tables cover cargo calculations. They are based on the latest metrological and accepted data. Other tables deal with such subjects as interrelation of units of measurement, capacities of pipelines, pipeline discharge rates, and pressure, calorific value, gravity, and temperature conversions.

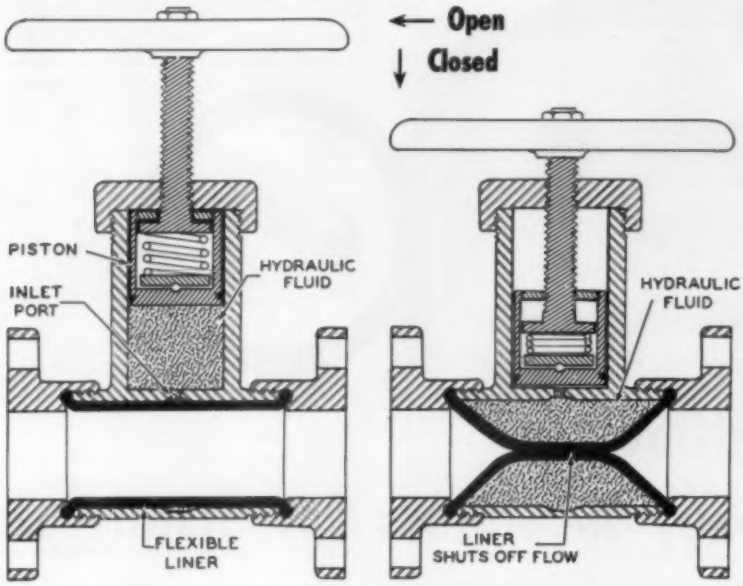
SYMPOSIUM ON MINIMUM PROPERTY VALUES OF ELECTRICAL INSULATING MATERIALS. Published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3. 48 pp. $1.75.

This symposium serves as an excellent starting point from which further research may go forward towards solving some of the perplexing problems associated with electrical insulation. The symposium includes several papers which answer some of the requirements for determining insulating properties.

ENTERPRISE IN OIL by Kendall Beaton. Published by Appleton-Century-Crofts, Inc., 35 West Thirty-second Street, New York 1. 815 pp. $7.50.

Here is the full story of the founding and growth of the American Shell companies in an interesting and entertaining history. Based on sound scholarship and nearly 10 years in preparation, this book is an accurate and lively account of a fast-growing company on the move. Shell Oil Co., today one of America's leading industrial concerns, has achieved its present size and scope in just over 40 years.

Note: The Oil and Gas Journal maintains a book department. Write to the READER SERVICE DEPARTMENT, P. O. Box 1260, Tulsa 1, for copies of the book list. Often books reviewed here may be purchased from this source.



OPEN POSITION of Hydro-Lok valve. CLOSED POSITION of Hydro-Lok valve.

New type of valve operates flexible liner hydraulically

STICKS, stones, nuts, bolts, or other foreign matter cannot interfere with the operation of a new type of valve called the Hydro-Lok developed by Ralph A. Kerr. The valve uses a flexible liner to cut off internal flow. If a screw or pebble ends up within the valve, the liner closes about it as the valve is tightened to make a bubble-tight seal.

Hydraulic pressure is the key behind the operation of the valve. Turn the handle and a piston moves within a hydraulic reservoir which is located within the bonnet. As the valve is closed, hydraulic fluid passes through a port into the body of the valve behind the flexible liner.

With the valve open, this liner is flush against the valve body; this provides unrestricted flow through its passage. As the valve is closed, the fluid pressure pushes the liner away from the body until the interior surfaces touch and this action shuts off flow through the valve.

In low-pressure tests (65 psi. city-water pressure) a working model cuts off the flow with a wooden pencil, a metal lag screw, and a piece of plastic-coated No. 8 wire successively inserted within the body. Paul Mallory, of American Flow Control, holders of manufacturing and merchandising rights, says the same principle will work under the higher range of operating pressures. To date, however, research has been limited to the lower pressures.

Characteristics of the liner will determine the operating pressure and type of service for the individual valve. It can be made of a wide range of materials, according to Mallory. Rubber, neoprene, plastic, and steel or nylon-reinforced rubber are some which qualify. With the liner's interchangeability, a valve can be used for any type of service.

This interchangeability highlights one of the valve's greatest assets—its simplicity, according to Mallory. The only moving part is the bonnet piston which is not subject to undue wear. Unscrew the two ends of the valve and a liner can be replaced in a few minutes in a plant or in the field. No seats, plugs, disks, or wedges interfere.

American Flow is pushing the valve through existing manufacturers rather than enter the field itself. It's set up to contract the manufacture of the valve on a royalty basis, Mallory says.

T.C.C. unit turnaround is made in 8 days

TURNAROUND of a T.C.C. unit was accomplished in less than 8 days recently by Bay Refining Corp. at Bay City, Mich. This is believed to be an all-time record for an operation which normally requires 10 to 14 days.

E. P. Bullock, T.C.C. superintendent, credits the record to "coordination, planning, and execution." Particularly important was a plan whereby the operators were divided into separate maintenance and operations groups and kept on these assignments until the turnaround was completed.

"We worked out everything we could in advance, and scaffolding and staging was all set up around the exchangers ahead of time, for example," Bullock says. "Oil was removed at 4 p.m., October 7 and it was back in at 1:15 p.m., October 15. We worked 10 hours per day."

Ten maintenance operators were assigned to feed preparation, and 14 operators to the catalyst. The latter crew decoked the reactor, repaired catalyst valves, vapor valves, and catalyst piping, and did the kiln work.

In this way there was no wait for the oil section to get ready when repairs were completed.

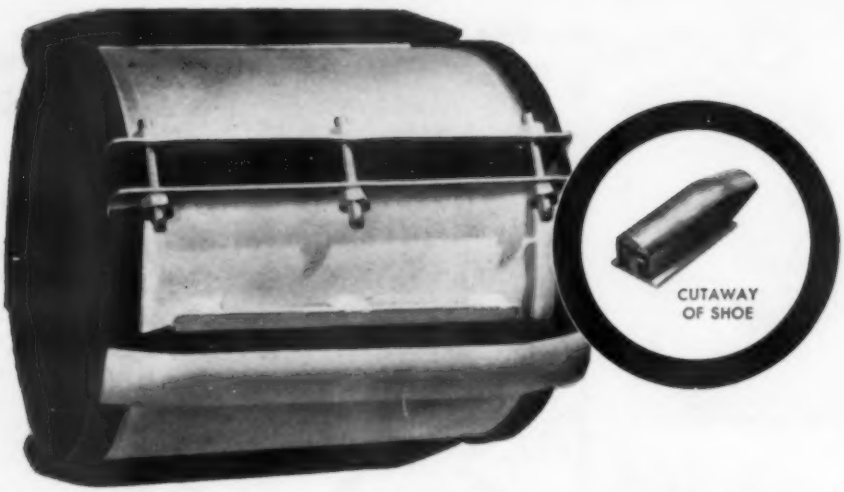
Bullock notes that the Bay Refining T.C.C. unit goes on turnaround twice a year, but also points out that his on-stream efficiency last year was 95 per cent. "And so far as I know we spent a good many less manpower hours on turnaround than most comparable units," he adds.

Bay Refining is a subsidiary of Dow Chemical Co.

New fire insulation protects equipment

INSULATION that confines the tremendous heat of manufacturing processes within pipes and vessels should also serve the secondary purpose of protecting structures and equipment (as well as the pipes and vessels) from fire on the outside in case of emergency. Such an insulation is a hydrous calcium silicate product developed especially to fit the needs of refineries. It has been de-

Model 55 Maloney Insulators for LARGE JOBS



Model 56 Maloney Insulators for Small Jobs

Maloney Insulators for *Every Job!*

Maloney Crossing Insulators for pipeline casing are exceptionally rugged, easy-to-install . . . *and adaptable to a wide range of pipe sizes and differentials.*

Because they are bonded metal-to-neoprene-to-metal, Maloney insulators provide good shock-absorption, plus flexibility to compensate for pipe shifting.

Streamlined "sled-type" steel runners make for easy entry into the casing, and prevent hanging-up on casing welds as pipe is being run.

Model 55 Maloney Crossing Insulators, in all sizes through 36", are fitted with an extra-wide steel band for positive grip. Model 56, for pipe sizes through 12" with 2" nominal pipe size differential, are fastened to the carrier pipe with stainless steel bands. Both types offer greater dependability—greater protection against corrosion with high dielectric strength neoprene, and against physical damage with steel runners—than any other insulator on the market. Maloney Crossing Insulators are in use on most of the country's major pipelines.

"Something from the Irishman"

F. H. MALONEY *Company*

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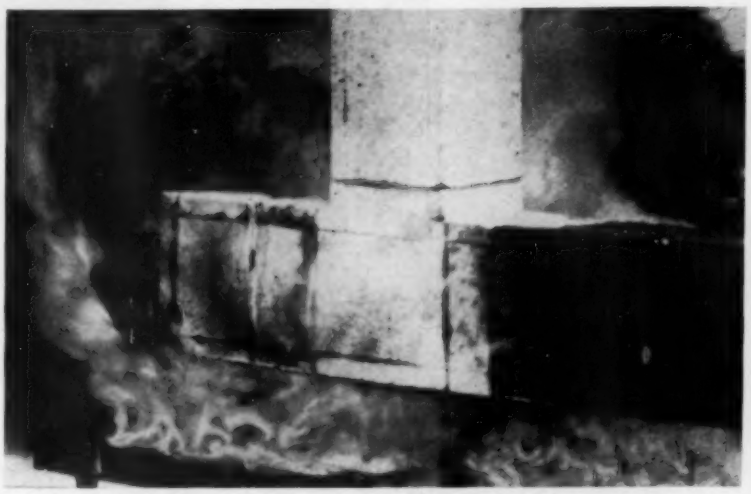
SINCE 1932 — PRECISION IN RUBBER — METAL — PLASTICS

veloped by Owens-Illinois Glass Co.

Sections of heavy, standard I-beams, encased in this insulation were subjected to the flames of an oil fire for 3 hours. Thermocouples placed in holes drilled in the beams registered the amount of heat that penetrated the insulation. During the test, temperatures on the outside of the insulated beams reached 1,980° F. Within the covering, the top temperature was 660° F.—far short of the heat required to affect the properties of steel.

The product has a third advantage beyond its thermal insulation and fire-resisting properties—it is unusually light. It weighs only 12 lb. per cu. ft. and it is practical and feasible to use as covering for existing steel structures. It may be applied "as is" indoors and with a protective weather jacket for structures exposed to weather.

Temperature was 1,980° F. but . . .



HYDROUS calcium silicate insulation saved these I-beams.

FOREST WILSON (second from left) receives $1,500 from T. P. Simpson (second from right) while Henry Nash (left) and A. E. Thompson look on. All are with General Petroleum Corp.

Coke-cutting tool saves time, power

THIS hydraulic coke-cutting tool caused Forest Wilson, stillman at General Petroleum Corp.'s Torrance, Calif., refinery, to receive an award of $1,500.

Its use will reduce cutting time (on the basis of a 30-day trail) 20 per cent each time a coking drum is emptied. As shown, the new cutter has only two nozzles instead of the four formerly used. Rate of water consumption remains substantially the same—1,200 g.p.m.; a higher nozzle pressure is attained.

Use of this coke-cutting tool will reduce over-all water consumption. This in turn will reduce the power requirements for operating the classifier, coke crusher, and slurry pump. Principal water savings will be realized through reduced steam consumption.

The new cutter is lighter than older designs. Its light weight makes it safer and easier to operate.

NEW TOOL reduces time 20 per cent.

Relocation develops better vent trap

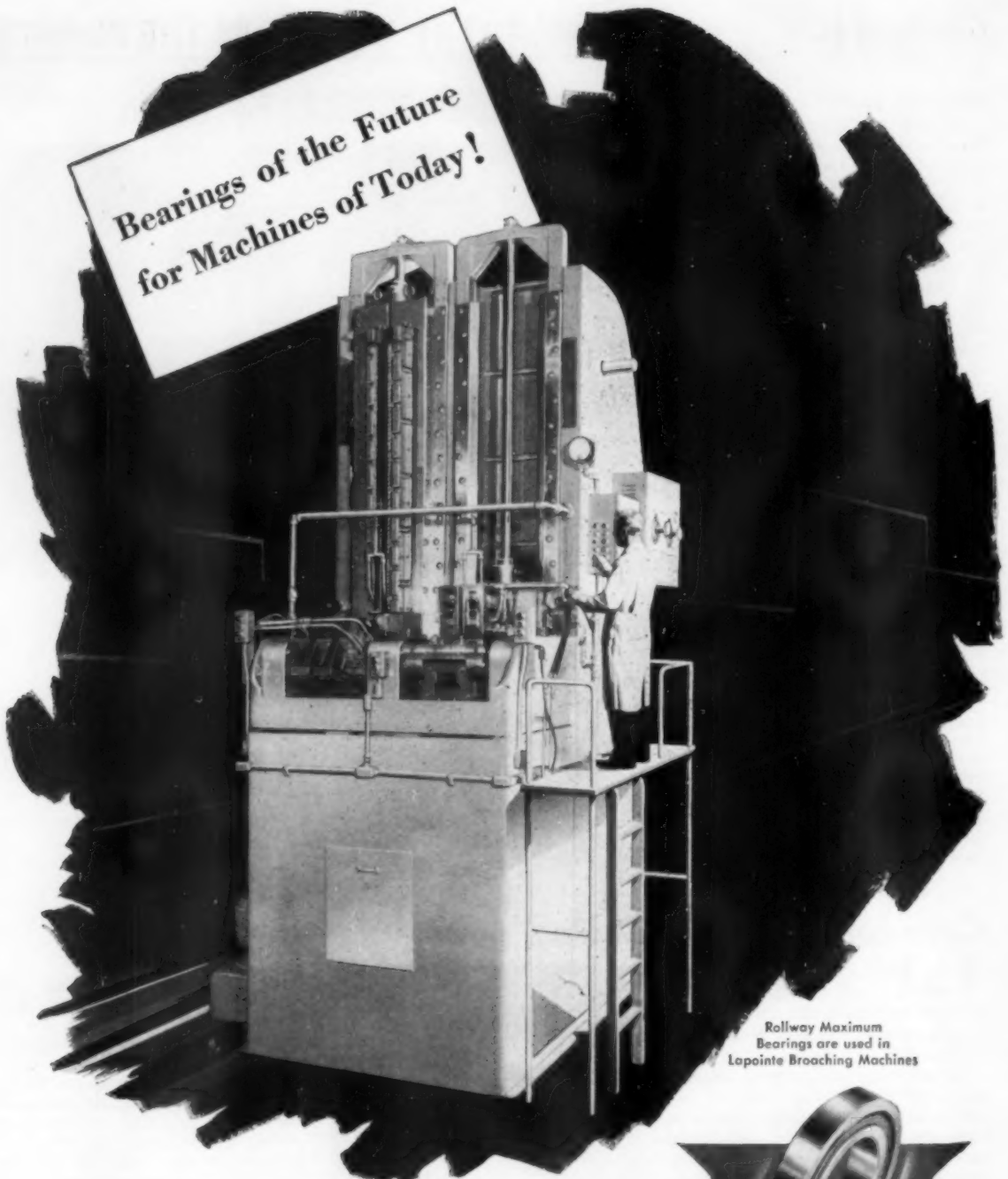
RELOCATION of the vapor vent trap for scavenger oil on Cooper-Bessemer Type GMV-10 T gas engines means less work and better housekeeping.

In earlier installations an oil-line header would pick up the excess oil and carry it to a trap. When enough oil had been accumulated, it would be poured into the crankcase. This job was eliminated when the vapor vent trap was relocated so the oil would drain directly into the crankcase through a closed system. It merely required mounting the trap in a new location on the engine and rearranging the piping from the various cylinders.

With this setup, the oil remains clean, no oil is lost in transfer, and none is being handled where it can be spilled accidentally on the floor.

This method of relocation was suggested by Oscar L. Martin, roustabout, Katy, Tex. Courtesy Humble Oil & Refining Co.

Bearings of the Future for Machines of Today!



Rollway Maximum Bearings are used in Lapointe Broaching Machines

Rollway roller bearings regularly offer performance capabilities for more than the needs of today. They are continuously anticipating the operating requirements of years ahead.

Wherever bearing precision and load values are important in your plant or products — for original equipment or replacement service — call on Rollway *bearings of the future*, to give you the utmost performance in your machines of today. Rollway Bearing Company, Inc., Syracuse 4, N. Y. Manufacturers of a complete line of radial and thrust cylindrical roller bearings.

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Heat Transfer

JOB IMPROVEMENT FOR THE PROCESS FOREMAN—89

Why Preheaters Are Installed on Furnaces

FOR the most part, all of the tube still heaters shown in Part 14 may be either sidewall-fired or floor-fired. With floor firing, which necessitates raising the floor of the furnace above ground, it is feasible to install a large number of small burners which increases the flexibility of the furnace and makes for more uniform distribution of heat.

Before the art of controlling radiant heat had been developed fully, many furnaces were constructed with recirculation in which some of the flue gases are brought back from the stack by the use of hot-gas fans and injected into the radiant section. The effect of recirculation is to reduce the percentage of radiant heat by lowering the firebox temperature and to increase the percentage of convection heat by increasing the volume and velocity of gases through the convection section.

This material is taken from "Fundamentals of Refining," operating manual of Magnolia Petroleum Co., refining division, Beaumont, Tex.

Preheaters in which the stack gases heat the air being used for combustion are installed on furnaces to increase the efficiency by lowering the temperature of the flue gas to the stack. Air preheat has the additional effect of increasing the percentage of radiant heat by increasing the firebox temperature. However, much of the refinery's flue gas is potentially corrosive because it contains water vapor and sulfur compounds as part of the combustion products.

If the flue gas is allowed to cool to or below the dewpoint, which is the temperature at which some of the water vapor will start to condense to liquid water, any material in contact with the flue gases will become coated with moisture that is acidic enough to be corrosive. This happens in air preheaters and has caused high maintenance costs on some air preheaters. In many instances, the cost of maintaining the preheaters has approached or exceeded the value of the fuel saved, which has discouraged their incorporation into the design of new heaters. **End.**

HEAT TRANSFER

Installments of this series have have appeared as follows:

Part 1—January 7, page 135
Part 2—January 14, page 129
Part 3—January 28, page 263
Part 4—February 11, page 129
Part 5—February 18, page 173
Part 6—February 25, page 143
Part 7—March 4, page 119
Part 8—March 18, page 151
Part 9—April 1, page 205
Part 10—April 8, page 119
Part 11—April 15, page 140
Part 12—April 22, page 144
Part 13—April 29, page 203
Part 14—May 6, page 139

CHART FOR OBTAINING GOOD COMBUSTION IN PROCESS-UNIT FURNACES

What to Accomplish	Instrument Required	Desired Reading of Instrument
1. Avoid positive pressure of flue gas in firebox	Draft gage connected to firebox roof.	Any negative reading.
2. Try to maintain maximum allowable firebox temperatures	Temperature indicator or recorder connected to firebox thermocouples.	Depends upon furnace design.
3. Maintain right amount of excess air	Draft gage connected to breeching, or stack, on the firebox side of the main damper, or—oxygen analyzer and recorder sampling breeching flue gas, or—CO_2 analyzer and recorder sampling breeching flue gas.	Depends upon furnace design.
4. A check on the amount of gas the furnace is burning	Fuel gas meter.	Least amount of fuel gas that will do the heating job.

Items 1 and 2 are special in that one or the other will show up as the limiting factor with respect to the maximum possible heating job of a particular furnace, unless unit equipment other than the furnace (such as tower pressure or pumps) are underdesigned relative to the furnace.

After an operator has reached the limiting factor on his furnace, whether it be Item 1, Item 2, or tower pressure, etc., then Items 3 and 4 should be checked and investigated by trial movement of the main damper until their best adjustment is obtained as reflected by the least amount of fuel gas being burned.

To help get this ideal furnace adjustment, particularly the initial adjustment after a turnaround, the test engineers are available.

Immediately after each adjustment by the test engineers, the operator can add to his log sheet the readings of each instrument used in Items 1, 2, 3, and 4. (From Item 2, log the highest of all the firebox temperatures.)

These records are very useful, because they will enable the operator to duplicate the furnace adjustment almost exactly any time in the future by moving the main damper until the same instrument readings are obtained, provided that the type of charge stock, charge rate, oil furnace-inlet temperature, and transfer-line temperature are about the same.

by W. L. Nelson
Technical Editor

COST-imating

30. Over-All Plant Costs—Miscellaneous

(Approximate)

Nelson Refinery Construction Cost Index*

	Material	Labor	M&L
1946	100	100	100.0
1947	122	113	117.0
1948	139	128	132.5
1949	144	137	139.7
1950	149	144	146.2
1951	164	152	157.2
1952	164	163	163.6
1953	172	174	173.5
1954	175	183	179.8
1955	176	190	184.2
1956	190	198	195.3

***The Oil and Gas Journal, July 7, 1952, p. 105. The Index also appears in the first issue each month and in addition, indexes for many items of equipment are published in the first issues of the months of January, April, July, and October.**

THE plant costs indicated here are most approximate. Variations of even plus or minus 80 per cent are not uncommon. When a capacity range is given, the low unit price applies to the large capacity. Thus, equipment for producing asphalt may cost $200 per daily barrel at a capacity level of 1,500 bbl. per day (making a total cost of $300,000) whereas a capacity of 5,000 bbl. per day, the total cost is only 5,000 × $135 or $675,000.

The costs of plants can be brought to date by the use of the Nelson Index which appears in the first issue each month of The Oil and Gas Journal. The Marshall and Stephens index of chemical processing equipment does not apply because it is an index of only the materials costs, and during recent years (since 1952) the cost of labor has risen faster than the cost of materials.

INDICATION OF COSTS OF VARIOUS REFINING PLANTS

Type of plant—	Capacity	Cost of labor and material (1946)
Acid-treating equipment		$19-39 per daily bbl.
Acid treating and rerun	15,000 B/D	$61 per daily bbl.
Alkylation		(See Cost-imating No. 27)
Alkyl benzene	350 B/D	$5,300 per daily bbl.
Ammonia plants		(See Cost-imating No. 29)
Aromatics recovery		(See Cost-imating No. 27)
Asphalt, loading and storage	600 B/D	$9.10 per daily bbl.
Asphalt processing	1,500-5,000 B/D	$135-200 per daily bbl.
Asphalt refineries		(See Cost-imating No. 27)
Benzene (and toluene) recovery		(See Cost-imating No. 27)
Butadiene	83-320 T/D	$26-210 per yearly ton
Butadiene, styrene and copolymer	125-1,100 T/D	$111-490 per yearly ton*
Centrifuge dewaxing, no rerun	600-1,000 B/D	$850-2,100 per daily bbl.
Carbon black (wide variations)	30-150 T/D	$550-1,200 per yearly ton
Clay burning, Thermofor	66 T/D	$1,600 per daily ton
Clay treating		(See Cost-imating No. 27)
Coal (hydrogenation)	300 T/D	$2,240 per daily ton
Coal for synthetic gasoline	2,000-27,000 B/D	$11,000-11,800 per daily bbl.
Coking		(See Cost-imating No. 28)
Copper sweetening plants, solid		$2.60 per daily bbl.
Copper sweetening plants, liquid	1,000-10,000 B/D	$5-19 per daily bbl.
Cracking (catalytic or thermal)		(See Cost-imating No. 28)
Cumene	500 B/D	$960 per daily bbl.
Deasphalting (propane)		(See Cost-imating No. 26)
Dehydration of gases		(See Cost-imating No. 29)
Desalting of crude oil		(See Cost-imating No. 26)
Desulfurization of gases		(See Cost-imating No. 29)
Desulfurization of liquids		(See Cost-imating No. 26)
Dewaxing (filter press)	400-1,200 B/D	$210-280 per daily bbl.
Dewaxing (solvent)		(See Cost-imating No. 26)
Dry ice	100 T/D	$4,300 per daily ton
Ethane recovery† from natural gas	300 M.M.s.c.f.d.	$12.8-15.2 per daily M.s.c.f.
Ethylene		(See Cost-imating No. 29)
Extractive distillation	420 B/D	$4,000 per daily bbl.
Fischer-Tropsch for synthetic gasoline	10,000-30,000 B/D	$8,300-9,000 per daily bbl.
Gasoline (natural) and cycling plants		(See Cost-imating No. 28)
Gasoline and kerosine treating	2,000-30,000 B/D	$23-102 per daily bbl.
Gray vapor-phase treating		$19-32 per daily bbl.
Hydrogen manufacture	200 M.s.c.f.d.	$755 per daily M.s.c.f.
Hydrogen sulfide removal		(See Cost-imating No. 29)
Hypersorption	2 to 100 M.s.c.f.d.	$8,000-75,000 per M.s.c.f.
Inhibitor injection		$0.25-2.50 per daily bbl.
L.P.G. bottling	3,500 gal./D	$13.7 per daily gal.
L.P.G. recovery		(See Cost-imating No. 26)
Lube oil (solution rerun)	1,000-5,000 B/D	$55-102 per daily bbl.
Lubricating oil plants		(See Cost-imating Nos. 26 and 27)
Methanol	1,600 B/D	$275 per daily bbl.
Nitric acid or urea		(See Cost-imating No. 29)
Oxygen		(See Cost-imating No. 29)
Para-xylene	5,000 T/Year	$244 per yearly ton
Phenol	6,000-17,500 T/Year	$145-305 per yearly ton
Polyethylene	33,000 T/Year	$3,600 per yearly ton
Polymerization (catalytic)		(See Cost-imating No. 26)
Polymerization (thermal)	100-600 B/D	$500-900 per daily bbl.
Reforming (catalytic)		(See Cost-imating No. 27)
Shale oil	3,000-40,000 B/D	$6,000-8,000 per daily bbl.
Solvent dewaxing or extraction		(See Cost-imating No. 26)
Stabilization (high pressure) in field	100-500 B/D	$30-60 per daily bbl.
Styrene	10,000 T/Year	$156 per yearly ton
Sulfur or sulfuric acid		(See Cost-imating No. 29)
Tetraethyl lead blending	1,000 B/D	$19 per daily bbl.
Topping (or atmospheric distillation)		(See Cost-imating No. 26)
Topping and thermal cracking refining		(See Cost-imating No. 27)
Vacuum flashing or distillation		(See Cost-imating No. 26)

*Copolymer. †30-42 per cent.

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THESE FEATURES STAND OUT

★ MUD PUMP DRIVE (optional) in twin-engine mechanical version becomes an integral part of the engine compounding arrangement. ★ CATHEAD SHAFT is located ahead of the driller for added safety. ★ MAST PIVOTING does not interfere with well head connections. ★ AIR ACTUATED CLUTCHES used throughout. All controls centralized at platform for safe, convenient operation. ★ COMPLETE SAFETY-TYPE CONDUIT LIGHTING SYSTEM for trailer and mast. ★ SUB-STRUCTURE has ample blowout preventer clearance and does not require trailer ramps.

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CERTIFIED POWER

FOR CAT* DIESEL ENGINES

CATERPILLAR TRACTOR CO.

ENGINE POWER CERTIFICATION

This is to certify that the Diesel Engine herein described has been engineered, manufactured and tested in accordance with rigid Caterpillar Standards. The materials and workmanship incorporated into this engine give it the inherent capacity for satisfactory performance when applied in accordance with the power ratings established and recommended by this company. The MAXIMUM OUTPUT capacity of this standard production engine is 200 H.P. @ 2000 R.P.M. equipped with: air cleaner, water pump, lubricating oil pump, fuel pump, and standard intake and exhaust manifolds.

I certify that B. L. Henson, Supervisor of Diesel Engine Test, Caterpillar Tractor Co., ... Certification and I affix my ... 19 57

B. L. Henson
Supervisor Diesel Engine Test
Caterpillar Tractor Co.
Peoria, Illinois

Caterpillar Model D326 Industrial ... was manufactured and shipped as follows: Engine Serial No. 39B1018 Shipping Date February 11, 1957

Power Setting 152 H.P. @ 1600 R.P.M. Intermittent Power Rating

Radiator & Fan
Ether Starting Aid
32V Charging Generator
Governor Control
Tachometer Drive
Muffler
Heater Connections
Remote Shut-off

POWER RATINGS

MAXIMUM OUTPUT is the horsepower capacity of the engine; a measure of the maximum power, @ 5%, that can be developed for five minutes without drop in speed.

INTERMITTENT HORSEPOWER is a rating for use in variable load applications such as excavators, hoists, and standby power units, where the duration of sustained full power output is one hour or less, with the average output not over 80% of Intermittent Horsepower.

RATED HORSEPOWER is a rating for use in applications such as planing mills, hammer mills, and rock crushers where the duration of sustained full power output is 12 hours or less.

CONTINUOUS HORSEPOWER is a rating for use in applications such as work boats and pumps where the duration of sustained full power output is 24 hours per day, day in—day out.

Horsepower figures are established in accordance with rigid Caterpillar standards. All ratings, corrected to sea level barometric pressure (29.92 in. Hg.) and standard temperature (60°F), apply to a production engine including air cleaner, water pump, lubricating oil pump, fuel pump and standard intake and exhaust manifolds. The above ratings are based on British and American BHP.

Printed in U.S.A.

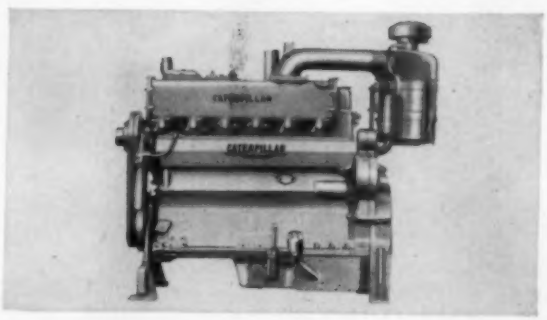
FORM NO. 910-33555

In a quarter century of diesel leadership Caterpillar Engines have achieved a reputation for *honestly rated power*. Owners have found that they can depend on a Cat Diesel to deliver the power promised.

Now, to back this reputation, Caterpillar becomes the *first* manufacturer to issue a certificate showing the horsepower capabilities of the engine. This certificate is signed by Caterpillar Tractor Co. and certified by a notary public.

You have a right to demand *certified power* when you invest in an engine. You get it when you buy from your Caterpillar Dealer. Let him show you the certified power plant that fits your needs.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.



CATERPILLAR*

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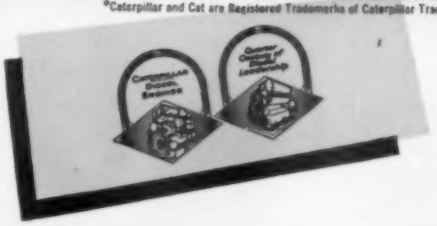
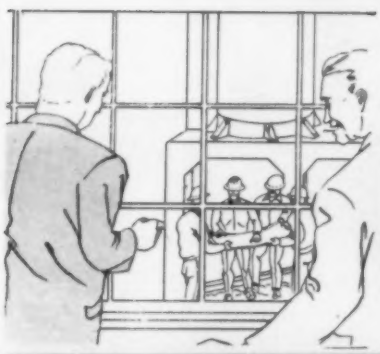


A 10-MINUTE JOURNAL FEATURE

Better Management

BUILDING LEADERS



Know qualifications for leaders

Encourage workers to be leaders

See that leadership is rewarded

BUILDING leaders means building a company's future. Without leadership, a company doesn't have much future at all. But leadership doesn't just happen in a company—at least not very often. Leadership, like any other talent, has to be encouraged. Even though a young foreman new on the job has leadership potentialities, a company still has to assist those potentialities into bloom. The company has to provide the environment, the attitude, the recognition that will encourage leadership to show itself most effectively.

Leadership in itself is, of course, an aggressive talent, and usually gives some indication that it's present. The trick is to bring it out in the open, define it, and put it into operation. Company management does this best by having a clear idea of what good leadership is and what the new recruit should show "signs of" before too much time has passed. By having some standards in mind, management can spot real leadership much easier.

First of all, a leader is a man who is interested in people—since leadership means leading people, not calculators or comptometers. Catch sight of a man who shows an interest in his fellow workers and you'll catch sight of a potential leader. Of course, this **interest** in people has to be backed up by an **understanding** of people; there's a difference between curiosity and real concern. And interest in people must finally be augmented by some very mature knowledge of the human personality and how it works.

Second, a leader is a man who appreciates facts—as opposed to opinions. A man's opinion can be quite pleasant but not very profitable at all to the business. Facts are safer, and a leader will get the facts and act upon them in making his decisions regarding people as well as company policy. Of course, a leader isn't so fact-bound that he has no imagination; he knows how to see beyond the facts into exciting new realms of company growth and success, but nevertheless he takes his first stand on proved knowledge and data.

Third, a good leader has his share of "positive thinking." He takes a positive—not a negative—approach to all problems. He'd rather go forward than backward. He'd rather create than destroy.

Fourth, a good leader has the courage to act when he arrives at what he believes is the right decision. The general may be a great military strategist, but until he marches into the field all the strategy is to no avail. A good leader is not afraid to state his case, act within his authorized province to achieve company goals in the way he believes best. And a good leader's not afraid—socially or professionally—of any colleague. There's no such thing as a "yes man" leader.

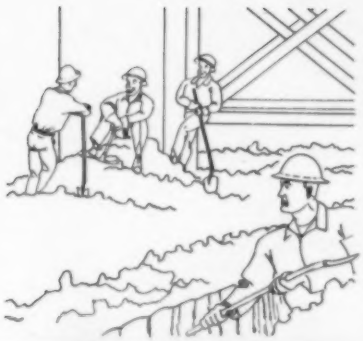
Finally, a good leader is a man who can communicate well. He's free of jargon, but can get technical when necessary. He doesn't wax eloquent, but he has a good command of vocabulary and English usage and can usually make sense the first time around. He can talk with the president and the office boy with equal ease, and he can get his ideas across to both the head of the research lab and the blonde secretary in the front office.

Of course, the responsibility for helping leaders along isn't solely that of company management. The potential leader himself has to indulge in a little self-analysis and self-improvement. He must take stock of himself along the way. To lead others, he has to be able to lead himself toward the goals he wants to achieve.

Perhaps the real cornerstone a potential leader can lay in building up his own leadership ability is to get straight in his own mind what kind of leader he wants to be. There was a time when boss dictatorships passed for leadership just as there was a time when "Why should I help anybody up the ladder of success? Who helped me?" passed for an adequate leadership philosophy. Today, however, leadership strives for a desired "company manner"—effective leadership on the job, serving the company, not just using the company for personal ambitions.

THE FUNCTIONS O

HANDLING GRIEVANCES



Understand causes of grievances

Understand the grievance

Explain and correct the situation

AS LONG as Univac is still under control and people are allowed to think for themselves, certain "differences of opinion" are inevitable. Every leader knows that. These differences, however, sometimes give rise to grievances among employes—because we have that healthy American notion that "if you get hit, you have the right to yell," and if you disagree, you have the right to speak up and say your piece. And it's rather certain that, with a number of opinions on hand, a leader picks only one to follow and files the rest away—sometimes leaving a few disgruntled employes behind.

Actually there are a number of legitimate reasons for workers' grievances. Probably the most popular causes are: a supervisor's showing favoritism in promotions; a supervisor's showing no interest in an employe's work; a fellow employe's stealing credit; an employe's job having some unpleasant or disagreeable aspect about it such as dirty working conditions or inadequate equipment. Then, too, there are grievances originating off the job. Some of the common off-job troubles that can interfere with a man's 8-to-5 life are housing difficulties, money problems, and family sickness. All these come up for supervisory attention, because any dissatisfaction becomes a supervisor's problem when it affects or threatens the work situation.

Once grievances—whatever their origin—do show up, there are two basic methods for handling them. A supervisor can assert his authority—that is, be regular commissar— or, he can be a good leader and turn the gripe or complaint into a chance to help the employe by using human, individualized, democratic methods. The commissar method destroys confidence, lower morale, and leaves the employe resentful and dissatisfied. The second method builds respect and confidence and leaves the employe satisfied and cooperative.

When an employe comes to the supervisor with a grievance—real or imaginary—the supervisor should listen sympathetically, let the worker "get it off his chest," and attempt to gather all the facts. The supervisor should remember, too, that the purpose of conferring with the worker is to get his story, and the worker should get to do most of the talking. It may help—once in a while—for the supervisor to restate what the worker is saying, just to be sure the situation is clearly understood. Restatement sometimes makes the worker feel that the supervisor is making every effort to be fair with him. Sometimes, too, it helps to ask the worker to restate his complaint, for by doing so the worker may change his way of expression and, unconsciously, throw new light on his grievance.

Once the supervisor understands the problem, then he must make or get a decision. In doing so, he might well remember the golden rule and try to put himself in the worker's position. After all, if the man **thinks** he has a problem, then he **does** have one—even if it doesn't appear so to the supervisor. And it will do little good to tell a worker to "just forget it." From little acorns mighty oaks do grow. Little incidents that are mishandled or ignored often grow into bigger grievances, and a dissatisfied and disgruntled worker will begin to find fault with many things, may even stir up trouble among other employes.

Rather than ignore grievances, a supervisor must decide upon some course of action, let the employe know what it is, sell him on its merits, and follow up—be sure any promises made are kept.

If leaders of a company do follow some sort of fair and square approach when grievances arise, fewer will develop. A reputation for sincerity and real interest in workers' problems will nip a lot of grievances in the bud. And to reduce the number of grievances still further—a supervisor should know his employes, be easy to approach, take care of the little things, sell plans in advance, be liberal with praise. Friendly, informed leadership is usually the most successful in handling any employe problem —and certainly makes the work situation more enjoyable for everyone concerned.

OF LEADERSHIP—2

EMPLOYEE DISCUSSIONS

Worker conferences build morale

Outline proposed conference

Encourage all to participate

ONE technique of good leadership is to talk things over with employes. Employes like to know "what's going on" in the company, what plans are shaping up, what problems need to be solved. A good general discussion now and then can build job loyalty, increase worker enthusiasm, and build up morale.

Just as a lot of grievance problems can be solved by a "neighborly" conference or talk with the individual involved, so can a lot of general company matters be settled, or at least clarified, by the group discussion. If a supervisor learns to take advantage of the planned discussion he'll find his job a lot easier and will find that a lot of employe friction gives way to cooperation and good will and that a stronger working relationship between the workers and supervisor is established. Whatever the purpose for the discussion—to promote good safety practices, to change methods and procedures, to change policies, to correct production difficulties, to brainstorm for new ideas—it can be used by the supervisor to set the whole tone of management-employe relations.

How to Lead a Discussion

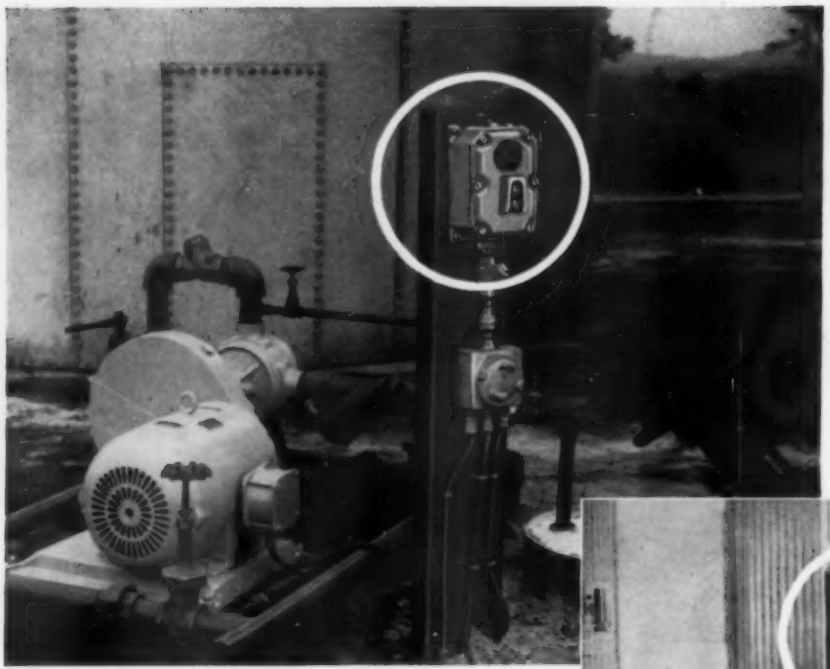
A discussion to be effective, however, must be something more than impromptu. To lead a good discussion, the supervisor should make an outline, determine who should attend, have necessary materials ready, and arrange the time and place. By knowing what he's going to talk about before he starts saves him a lot of time and a lot of "going all around the barn." A good discussion leader, also, should always be in control of the discussion, guiding it toward positive results. He should encourage participation and give everyone a chance to take part; he should make it easy for employes to pool their ideas and exchange their experiences; he must see that personal feelings don't get involved.

The most important part of the discussion, for the leader, will of course be the summary. It is the discussion leader's job to recognize the highlights of the discussion and to evaluate the opinions, suggestions, and experiences presented. It's also the leader's job to decide on a plan of action—if one is called for—and to decide how to handle the group's problems, proposals, and recommendations. If a discussion fails it is usually the leader's fault—either he directed the discussion poorly or fails to do anything with the results of the discussion.

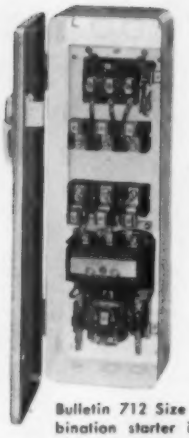
A good discussion, however—properly led and properly handled after the discussion is over—can mean a great deal for a company. Production bottlenecks can be solved more quickly, and the time taken from production to hold the discussion is more than made up later. Workers— once accustomed to the idea of group discussions—keep an eye out for work problems and bring them to the group's attention; together, workers and management may find better solutions than management could find by itself. Also, discussions have a good effect on worker morale. Better understanding of company policies and plans means increased worker interest and job satisfaction; morale is raised by recognition received in group discussions and the sense of "togetherness" employes can get from having a chance to talk things over.

Because group discussions are important, a good leader obviously should master the techniques of organizing and directing them. Group discussions are another supervisory tool and like any other tool should be used by a good leader when appropriate. After all, company leadership must rely on as many "tricks of the trade" as possible and must be willing—and prepared—to use whatever legitimate devices are needed to produce results, solve problems, set standards, and fulfill the various other functions of effective leadership in modern business and industry.

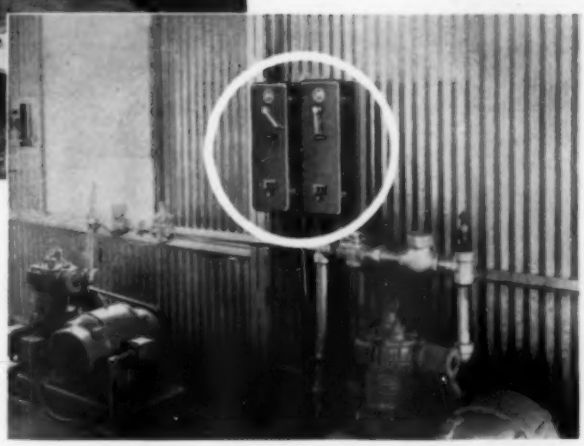
(Additional copies free on request)



Oil circulating unit for treating crude oil, equipped with Allen-Bradley Bulletin 609 manual starter in explosion-proof enclosure.



Bulletin 712 Size 2 combination starter in general purpose enclosure.



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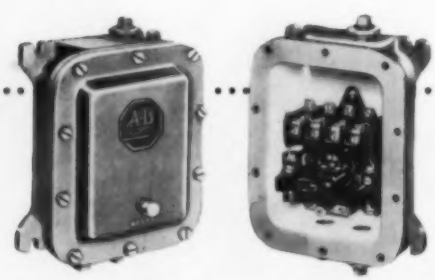

Bulletin 709 automatic across-the-line motor starter in NEMA Type 7 explosion-proof bolted enclosure.

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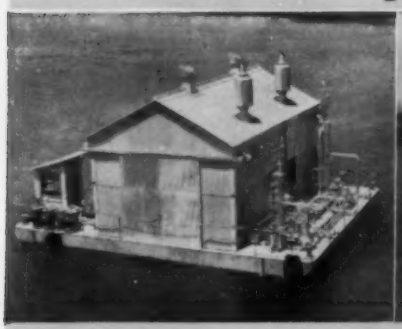

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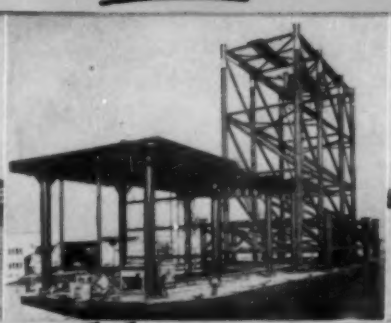
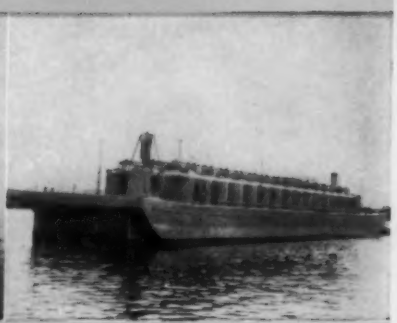

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Call the distributor nearest you: **Cathodic Protection Service, Houston, Texas • Corrosion Services, Inc., Tulsa, Oklahoma • Electro Rust-Proofing Corp. (Service Division), Belleville, N. J. • Ets-Hokin & Galvan, San Francisco, Calif. • The Harco Corp., Cleveland, Ohio • Royston Laboratories, Inc., Blawnox, Penna. • Stuart Steel Protection Corp., Plainfield, N. J. • The Vanode Co., Pasadena, Calif.**

YOU CAN DEPEND ON DOW

Pipeline Patrol

. . . Report on Construction

PIPELINE activity reported here is compiled from surveys conducted by The Oil and Gas Journal among pipeline companies and contracting firms. Projects listed include those proposed, contracted, and under way.

U.S. Crude-Oil Pipelines

• **Cape Pipe Line Co.** (organized by Sun Oil Co., Cities Service Co., Atlantic Refining Co.)

Project: Long range plans for line on the lower Delaware Bay to the Philadelphia refining area.

Completion: 1960.

• **Four-Corners Pipe Line Co.** (newly formed by Shell Oil Co., Standard Oil Co. of California, Continental Pipe Line Co., Gulf Oil Corp., Richfield Oil Corp., Superior Oil Co.)

Project: 600 miles of line from near Farmington, N. Mex., in the Four Corners area to Los Angeles, to be constructed and operated by Shell Pipe Line Corp. as agent for the companies.

Status: Under way.

Completion: End 1957.

• **Fulton, R. H. & Co.,** Lubbock, Tex.

Project: 39 miles of 6-in. from Donkey Creek field in northeastern Wyoming, southeast to the Osage pump station in Weston County.

Status: Fulton, a contractor has applied to Wyoming Public Service Commission.

• **Interstate Oil Pipe Line Co.**

Project: 5 miles of 4-in. from South Bosco field, Louisiana, to present main line, and 5 miles of various size from Church Point field, Louisiana, to present main line.

Status: Proposed.

• **Magnolia Petroleum Co.**

Project: 203 miles of 12, 16, and 20-in. loops between Midland and Beaumont, Tex.

Status: To start August 1957.

Contractor: **O. R. Burden Construction Corp.** has 121 miles of 16-in. and 5 miles of 12-in. between Midland and Corsicana. **H. B. Zachry Co.** has 77 miles of 12, 16, and 20-in. between Corsicana and Beaumont.

Completion: Early 1958.

• **Muskegon Pipe Line Corp.** (newly formed by Aurora Gasoline Co. and Service Pipe Line Co.)

Project: 165 miles of 10-in. from Griffith, Ind., to Muskegon, Mich.

Status: Planned.

Completion: Late 1957.

• **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)

Project 80 miles of 8-in. and 300 miles of 10-in. crude and products line from Four Corners area to Salt Lake City.

Status: Proposed.

• **Offshore Gathering Corp.,** Houston.

Project: 364 miles of mostly 20-in. in Gulf of Mexico off Louisiana. (Dual line.)

Status: Proposed.

• **Pasotex Pipe Line Co.**

Project: 58 miles of 20-in. between Wink and El Paso, Tex.

Status: To start in June.

Contractor: **R. H. Fulton & Co.**

Completion: September 1, 1957.

• **Salt Lake Pipe Line Co.**

Project: 100 miles of 10-in. looping of Rangely, Colo., to Salt Lake City line.

Status: Pipe has been ordered.

Completion: Late 1957.

• **Shamrock Oil & Gas Corp.**

Project: 35 miles of 6-in. to serve fields in Ochiltree and Hansford counties in the Texas Panhandle.

Status: Under way.

• **Shell Oil Co.**

Project: Undetermined length of 3, 4-in. in South Louisiana.

Status: Under way.

Contractor: **Brown & Root, Inc.,** W. P. Stanley, spread superintendent, office at Buras, La.

Completion: September 30, 1957.

• **Sinclair Pipeline Co.**

Project: 150 miles of 20-in. from Teague, Tex., to Houston.

Status: Planned for 1958.

Completion: 1958.

• **Skelly Oil Co.**

Project: 38 miles of 8-in. extension of its gathering system into southern Kiowa County, Kansas.

Status: Planned.

Completion: Early fall 1957.

• **Southern Kansas Pipeline, Inc.** (newly organized).

Project: 200 miles of 6 to 10-in. from southwestern Meade County to a point in Cowley County, 10 miles north of Arkansas City.

Status: Proposed. Request filed with Kansas Corporation Commission for permit.

• **Tecumseh Pipe Line System** (Joint venture of Sinclair Pipe Line, Ashland Oil & Refining, and Pure Oil Co.)

Project: 201 miles of 20-in. between Griffith, Ind., and Cygnet, Ohio.

Status: Under way.

Contractor: **O. R. Burden Construction Corp.** has two spreads of 93 miles from Griffith eastward and 92 miles from the mid-point to Cygnet. The 16 miles from Chicago to Griffith has not been let.

Completion: September 1957.

• **Texas-New Mexico Pipe Line Co.** (owned by The Texas Co., Sinclair Pipe Line Co., Tidewater Oil Co., and Empire Gas & Fuel Co.)

Project: 515 miles of 16-in. from southeast corner of Utah to Jal in southeastern New Mexico.

Status: to start late 1957.

Contractor: Survey contracts went to **J. V. McCoy,** Houston, and **E. H. Schmidt and Associates,** Tulsa.

Completion: 1958.

U.S. Products Pipelines

• **Alaska-Yukon Refiners & Distributors, Ltd.**

Project: Two lines: one 150 miles from Haines to Haines Junction, Alaska, linking with government Canol line; another from Tok Junction, on the Canol line, to Anchorage.

Status: Proposed.

Completion: 1959.

• **American Pipe Line Co.**

Project: Line from Gulf Coast to New York City area. Received ODM approval to amortize 40 per cent of $175,000,000 cost with a rapid writeoff.

Status: Proposed.

• **Buckeye Pipe Line Co.**

Project: Conversion of 116 miles of 8-in. crude to products between Huntington, Ind., and Griffith, Ind.

Status: under way.

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Mapp Tank Co.
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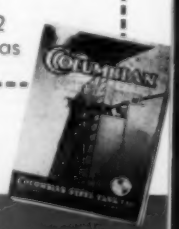

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Pipeline Patrol

Contractor: **Sheehan Pipe Line Construction Co.**, C. M. Brown, superintendent, office at Rochester, Ind.
Completion: Fall 1957.
Project: Conversion of 32 miles of 8-in. crude to products between Mantua, Ohio, and Youngstown area.
Status: Planned.
Contractor: Company will do own work.
Completion: November 1957.

• **Cities Service Pipe Line Co.**
Project: 29 miles of 6-in. ethylene line from Lake Charles, La., to Orange, Tex.
Status: Planned.
Completion: July 31, 1957.
Project: 168 miles of 6-in. L.P.G. line from East Chicago, Ind., to Lowell, Mich.
Status: To start June 1, 1957.

• **Continental Pipe Line Co.**
Project: Conversion of 99 miles of 6-in. from the Wichita Falls area to near Fort Worth, Tex., plus a 15-mile extension of the line to the Grapevine area northeast of Fort Worth.
Status: Conversion under way. Extension planned.

• **El Paso Natural Gas Co.**
Project: 11 miles of 4-in. L.P.G. products from Snyder Line to South Andrews Plant, Texas.
Status: Planned.
Project: 240 miles of 6-in. from Odessa to El, Paso, Tex.
Status: Planned.
Contractor: **Pipeline Engineering Co.** has design and engineering contract.
Completion: Early 1958.

• **Engineering Management, Inc.**
Project: 58 miles of 10-in. from Richmond to Castle, Calif.
Status: Under way.
Contractor: **Hood Construction Co.**, William Burgess, spread superintendent, office at Sacramento.
Completion: July 1, 1957.

• **Great Lakes Pipe Line Co.**
Project: 84 miles of 8-in. from south of St. Paul to Eau Claire, Wis.; 68 miles of 12-in. from Great Lakes intersecting point with Badger Pipe Line to Chicago.
Status: Construction scheduled to start spring 1957.
Project: 15 miles of 6-in. from Lincoln, Neb., to Lincoln air base.
Project: 140 miles of 8-in. from Minneapolis to Superior terminals.
Project: 34 miles of 12-in. from Tulsa to Barnsdall, Okla., to supplement existing 12 and 8-in. lines.
Project: 14 miles of 8-in. from Coffeyville to Independence, Kan., to replace present 4-in line.
Project: 11 miles of 8-in. from approximately 10 miles east of the Great Lakes pumping station at Donahue, Iowa, to terminals on the Mississippi River at Bettendorf, Iowa.

• **Gulf Refining Co.**
Project: 530 miles of 10-in. L.P.G. and natural gasoline line from Waddell Plant in Crane County, Texas, to Mont Belvieu near Houston (368 miles is converston from crude service).
Status: Under way.

• **Laurel Pipeline Co.** (Gulf Refining Co. and Sinclair Pipe Line Co.)
Project: A 24-in. line from the Philadelphia refining area to Cleveland.
Status: Under consideration.

• **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)
Project: 80 miles of 8-in. and 300 miles of 10-in. products and crude line from Four Corners area to Salt Lake City.
Status: Proposed.

• **Ohio Oil Co.**
Project: 350-miles of 12-in. from Wood River, Ill., to Chicago.
Status: Work to start fall 1957.
Completion: 1958.

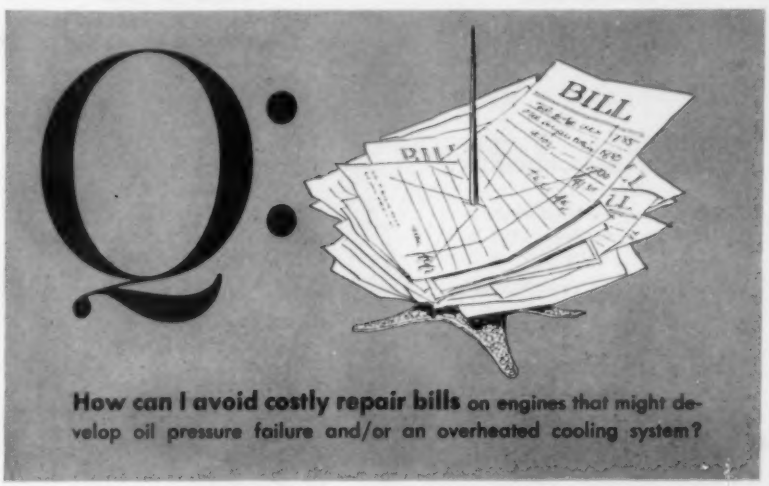
• **Salt Lake Pipe Line Co.**
Project: 80 miles of 8-in. looping of line from Boise, Idaho, to Pasco Wash.
Status: Pipe has been ordered.
Completion: Late 1957.

• **Southern Pacific Pipe Lines, Inc.**
Project: 100 miles of 10-in., 80 miles of 8-in., and 125 miles of 6-in. between Richmond, Calif., and Fallon, Nev.
Status: Under way.
Contractor: **River Construction Corp.** has 84 miles of 8, 10-in. from Richmond to Stockton, Calif. to complete late spring 1957, F. O. Traweek, spread superintendent, office at Richmond. **Hood Construction Co.**, Lynwood, Calif., has 58 miles of 10-in. from Stockton to Roseville, Calif. **Engineers, Limited Pipeline Co.** and **Joe E. Young Pipe Line Construction Co.** have 18 miles of 6 and 8-in. between Roseville and Donner Summit.
Completion: August 1, 1957.

• **Trust Pipe Line Co.** (Cosden Petroleum)
Project: 128 miles of 6-in. from Hawley, near Abilene, to Wichita Falls, Tex.
Status: To start July 1957.
Contractor: **Pipe Line Technologists, Inc.**, has the design and engineering.
Completion: October 1957.

• **Underground Storage & Exploration, Inc.**
Project: 393 miles of 12-in. L.P.G. line from Moundsville, W. Va., to Newark, N. J., plus 95 miles of 6, 8-in. laterals to Mauch Chunk, Pa., and to Philadelphia.
Status: Proposed.

• **Union Oil Co. of California**
Project: 815-mile line from Rifle, Colo., to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Pipeline Patrol

Los Angeles refining area, to carry products from its proposed Rifle shale-oil plant.
Status: Proposed.

U.S. Natural-Gas Pipelines

- **American Louisiana Pipe Line Co.**
  Project: 7 miles of 16-in. and 5 miles of 12-in. at North Holly Beach Field and Second Bayou Field, Cameron Parish, La.
  Status: Has temporary FPC permit.
- **Arkansas Louisiana Gas Co.**
  Project: A 300-mile line from Texas-Louisiana coastal region to northern Louisiana, to connect with their present system, plus gathering lines.
  Status: Long-range plans.
- **Carolina Pipeline Co.**
  Project: 177 miles of 2, 3, 4, 6, 8, and 10-in. between Blacksburg and Camden, S. C.
  Status: Work to start June 1, 1957.
  Contractor: **Panama-Williams Corp.**
- **Central Hudson Gas & Electric Corp.**
  Project: 46 miles of 10-in. from Albany to Kingston, N. Y.
  Status: To start May 16, 1957.
  Contractor: **Williams-Austin Construction Corp.**, O. L. Martin and Ralph Gaddy, spread superintendents, office at Catskill, N. Y.
  Completion: November 1, 1957.
- **Cities Service Gas Co.**
  Project: 8 miles of 16-in., 20 miles of 8-in., 20 miles of 6-in., and 20 miles of 4-in. field lines in Barber County, Kansas.
  Status: Approved. Under way.
  Contractor: **Vaughn & Taylor Construction Co.**
  Project: 3 miles of 12-in., 8 miles of 10-in., 4 miles of 8-in., 8 miles of 6-in., and 37 miles of 4-in. field lines in Eureka Field, Okla.
  Status: Approved. Under way.
  Contractor: **Vaughn & Taylor Construction Co.**
  Project: 4 miles of 16-in. at Sarcoxie, Mo.
  Status: Approved. Under way.
  Contractor: **Prairie Construction Co.**
  Project. 64 miles of 6 to 30-in. in Leavenworth and Anderson counties, Kansas, Cass County, Missouri. and Oklahoma County, Oklahoma.
  Status: Planned.
- **Coastal Transmission Corp.**
  Project: 575 miles of 12, 20, 22, 24-in. main line and 414 miles of 2 to 14-in. gathering lines between McAllen, Tex., and Baton Rouge, La.
  Status: To start summer 1957.
  Completion: January 1, 1958.
- **Colonial Natural Gas Corp.**
  Project: Two systems; one between Houston-Lake Charles area and Miami, Fla.; one in the Carolinas and Georgia.
  Status: Proposed.
- **Colorado Interstate Gas Co.**
  Project: 1957 program . . . 66 miles of 10-in., 40 miles of 34-in., 109 miles of 26-in., and 100 miles of 24-in. from Springfield, Colo., to Pueblo, Colo; 345 miles of 30-in. from Kit Carson, Colo., to Beatrice, Neb.; 50 miles of 22-in. from Laverne to Hooker, Okla.; 24 miles of 22-in. Panhandle field looping.
  Status: Pending FPC approval.
- **Eastern Shore Natural Gas Co.**
  Project: 34 miles of 8-in. and 90 miles of 6-in. from connection with Transcontinental Gas Pipe Line Corp. in Maryland, across entire length of Delaware to Salisbury.
  Status: Pending FPC approval.
- **El Paso Natural Gas Co.**
  Project: 74 miles of 34-in. San Juan main line loops.
  Status: Planned. Filed for FPC permit.
  Completion: August 1957.
  Project: 94 miles of 18-in. from Panoma

Pipeline Patrol

Plant, Gray County, to Dumas Plant, Moore County, Texas.

Status: To start May 1957.

Contractor: **R. H. Fulton & Co.**

Completion: July 1957.

Project: 177 miles of 20-in. from Sonora Plant, Sutton County, to Plains Plant, Yoakum County, Texas.

Status: Planned. Filed for FPC permit.

Completion: January 1958.

Project: 74 miles of 30-in. Permian-San Juan main line loops.

Status: Planned. Filed for FPC permit.

Completion: January 1958.

Project: 216 miles of 6 to 34-in. in Arizona, Texas, and New Mexico, plus 533 miles of various size line.

Status: Filed for FPC permit.

Project: 47 miles of 30-in. from proposed Lindrith, N. M., plant to proposed Chaco, N. M., plant.

Status: To start May 1957.

Contractor: **Foutz & Bursum Construction Co.**

Completion: 1957.

- **Houston Texas Gas & Oil Corp.**

Project: 702 miles of 24-in. from Baton Rouge, La., to Kissimmee, Fla.; 240 miles of 18-in. from Kissimmee to Cutler, Fla.; 642 miles of 3 to 18-in. sales laterals in Florida. Main line to join Coastal Transmission's proposed line from McAllen, Tex., to Baton Rouge.

Status: To start June 1957.

Contractor: **Midwestern Constructors** has the 702 miles of 24-in.; **Harbert Construction Corp.** has remainder.

Completion: June 1958.

- **Iron Ranges Natural Gas Co.**, St. Paul.

Project: 68-mile transmission line and 47 miles of laterals to supply towns on the Mesabi Iron Range, Minn.

Status: Application pending with FPC.

- **Kansas-Nebraska Natural Gas Co.**

Project: 61 miles of various size gathering line in Camerick field, Texas County, Oklahoma.

Status: Approved.

- **Michigan Consolidated Gas Co.**

Project: 67 miles of 10 and 12-in. between Sears and Travers City, Mich.

Status: Under way.

Contractor: **Somerville Construction Co.**; Floyd Huduall, spread superintendent, office at Cadillac, Mich.

Project: 60 miles of 10 and 12-in. between Muskegon and Ludington, Mich.

Status: Under way.

Contractor: **Somerville Construction Co.**, jointly with **J. L. Gentry Construction**; **Frank** Morris, spread superintendent, office at Hart, Mich.

- **Michigan Wisconsin Pipe Line Co.**

Project: 24 miles of 24-in. and 18 miles of various size looping in Michigan, Indiana, Illinois, Wisconsin, Iowa, and Missouri.

Status: Approved.

Completion: October 1, 1957.

- **Midwestern Gas Transmission Co.**

Project: Will build main line from Portland, Tenn., to Canadian border near Emerson, Man.; 829 miles of 24-in., 109 miles of 16-in., 174 miles of 12-in., 648 miles of 3 to 18-in. extensions in Minnesota and Wisconsin.

Status: Application pending with FPC.

- **Mississippi River Fuel Corp.**

Project: 125 miles of loops along portions of present lines from fields in Louisiana and eastern Texas, to St. Louis.

Status: Planned.

- **Mountain Fuel Supply Co.**, Salt Lake City

Project: 38 miles of line to connect with Pacific Northwest Pipeline Corp.'s system in Sweetwater County, Wyoming.

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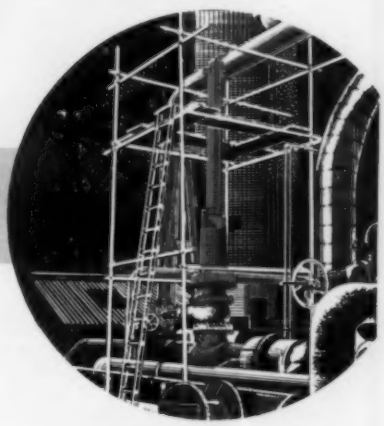

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Pipeline Patrol

Status: Has temporary FPC permit.

• **Natural Gas Pipeline Co. of America** deen, S. D., line.

Status: Under way.

Contractor: **Troth Construction Co.**

Project: 73 miles of 20-in. from Savana Creek to Pincher Creek fields in Alberta, Canada; 32 miles of 24-in. from Pincher Creek to Montana border; 1,100 miles of 26-in. from Montana into Minneapolis.

Status: Planned.

Project: 365 miles of main line and 1,090 miles of branch lines to serve communities in Minnesota, Iowa, South Dakota, Nebraska, and Wisconsin.

Status: Filed with FPC March 18, 1957.

• **Offshore Gathering Corp.,** Houston.

Project: 364 miles in Gulf of Mexico off Louisiana.; 60 miles of 24-in., 70 miles of 26-in., 234 miles of 30-in. (Dual line.)

Status: Application pending with FPC.

• **Ohio Fuel Gas Co.**

Project: 7 miles of 12-in. near Fremont, Ohio.

Status: Planned.

Completion: First half 1957.

Project: 23 miles of 18, 20-in. from Gibson-

Project: 350 miles of 20 and 26-in. from Jack and Wise counties, Texas, to Fritch, Tex., plus a gathering system.

Status: Under way.

Contractor: **R. H. Fulton & Co.** has Red River crossing in northern Montague County. **Fulton & Brodie, Inc.,** Lubbock, Tex., has gathering system.

Completion: Total project to be completed by December 1, 1957.

Project: 389 miles of 36-in. loops along its line from Beatrice, Neb., to Chicago, to take gas from proposed line of Colorado Interstate Gas Co., and for 91 miles of 30-in. loops along parts of its main line.

Status: Application pending with FPC.

Project: 337 miles of 30-in. between Fritch, Tex., and Beatrice, Neb., and 59 miles of 36-in. between Beatrice and Joilet, Ill., along Natural's existing system from the Texas Panhandle to Chicago.

Status: Pending FPC approval.

Completion: 1959.

• **New York State Natural Gas Corp.**

Project: 15 miles of 30-in. from Horseheads to Newfield, N. Y.; 31 miles of 20-in. from Harrison to Woodhull, N. Y.; 10 miles of 12-in. from Stockbridge to Oneida, N. Y.

Status: Planned.

• **Niagara Mohawk Power Corp.**

Project: 14 miles of 18-in. from Phoenix to Palermo, N. Y.

Status: Planned.

Completion: October 1, 1957.

Project: 261 miles of 2 to 16-in. transmission and distribution mains to service areas in central, eastern and northern New York state.

Status: Planned.

Contractor: Various.

Completion: December 31, 1957.

• **North Carolina Natural Gas Corp. (Subsidary of Colonial Natural Gas Corp.)**

Project: 630 miles of 2 to 16-in. from Transcontinental Gas Pipe Line Corp.'s system near Mooresville, eastwardly across north Carolina.

Status: To start fall 1957.

Completion: Spring 1958.

• **Northern Natural Gas Co.**

Project: 160 miles of 2, 3, 6, 8-in. branch lines to serve 20 new communities on Aberburg to Toledo.

Status: Uncertain.

Project: 152 miles of line in Ohio: 43 miles of 24-in. from Crawford Station to Utica; 18 miles of 24-in. from Pavonia Station to Line D; 6 miles of 20-in. from Mount Gilead to Claridon; 4 miles of 20-in. near Dayton; 4 miles of 20-in. near South Charleston; 7 miles of 16-in. near Springfield; 6 miles of 20-in. nnear Oberlin; 17 miles of 20-in. from Oak Hill to Symmes Station; 7 miles of 12-in. from Mount Sterling to Bloomingburg; 2 miles of 8-in. near Bellefontaine; 3 miles of 12-in. near Mansfield; 4 miles of 12-in. near Lakeville; 7 miles of 8-in. in Guernsey and Belmont counties.

Status: Under way.

Contractor: **O. R. Burden Construction Corp.** has the 43 miles of 24-in. from Sugar Grove near Crawford station, to Utica, Ohio, C. M. Hoffman, spread superintendent.

Completion: O. R. Burden Construction Corp., section to be completed July 1, 1957. Remainder to be completed second half 1957.

• **Pacific Gas & Electric Co.**

Project: 37 miles of 20-in., 37 miles of 18 in., 3 miles of 16-in. from Beehive Bend field near Willows, Calif., to near Davis, then to Sacramento.

Status: Under way.

Contractor: **Engineers Limited Pipeline Co.**

Completion: June 1957.

Project: 138 miles of 34-in. looping of the Topock-Milpitas line.

Status: Under way.

Contractor: **Midwestern Constructors, Inc.**

Completion: December 1, 1957.

Project: 5 miles of 16-in., 160 miles of 12-in., 8 miles of 6-in. from Corning to Eureka, Calif., to connect company's Humboldt Division with integrated gas system.

Status: Planned.

Completion: January 1958.

Project: 13 miles of 12-in., 2 miles of 10-in., from Santa Cruz to Davenport, Calif.

Status: Planned.

Completion: October 1957.

• **Pacific Northwest Pipeline Corp.**

Project: 37 miles of 6-in. from Dove Creek to Nucla, Colo., and 13 miles of 4-in. from Nucla to Urvan, to serve Union Carbide

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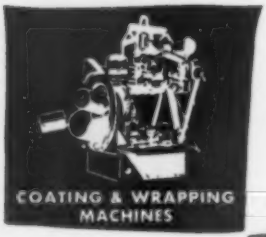
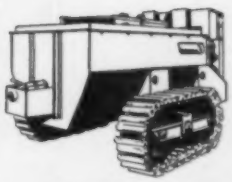
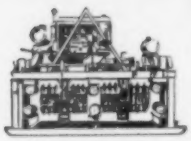

COATING & WRAPPING MACHINES


PIPELINE KETTLES

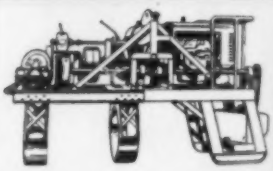
CUTTING & BEVELING MACHINES


STATIONARY CLEANING & PRIMING MACHINES

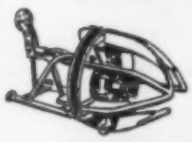
CROSE

CLEANING & PRIMING MACHINES

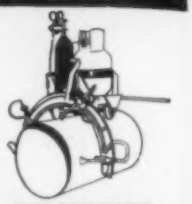
THE NAME THAT MEANS EVERYTHING


ROAD BORING MACHINES

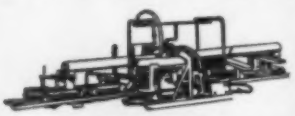
ENDLESS PIPE BELT SLINGS


INTERNAL LINEUP CLAMPS

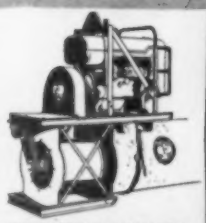
TO PIPELINING

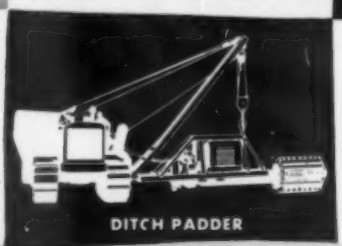

PIPE PREHEATER

PATCH KETTLES


STATIONARY COATING & WRAPPING MACHINES

PIPELINE CRADLES


PIPELINE DEFROSTER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Pipeline Patrol

Nuclear Co. and Vanadium Corp. of America.

Status: Has FPC permit.

Project: 1,000 miles of gathering lines and laterals along present line.

Status: Planned.

Completion: 1957.

- **Pennsylvania Gas Co.**

Project: 23 miles of 10-in. in Erie County, Pa., 15 miles of 8-in. in Warren and Chautauqua counties, Pennsylvania, 30 miles of branch lines and a number of small distribution systems.

Status: Has FPC permit.

- **Peoples Natural Gas Co.**

Project: 58 miles of 2 to 14-in. extension and replacement lines in Pennsylvania.

Status: Under way.

Completion: September 1957.

- **Permian Basin Pipeline Co.**

Project: 83 miles of 16-in. from its Spraberry station in Midland County, Texas, to tie in with Pioneer Gathering System, Inc., at a point in northwestern Schleicher County, Texas.

Status: Filed for FPC approval.

- **Phillips Petroleum Co.**

Project: 3 miles of 24-in. in Moore County, Texas.

Status: Planned.

Completion: October 1, 1957.

Project: 30 miles of 3 to 8-in. in Moore, Hutchinson, Sherman, Hansford, and Gray counties, Texas, and in Texas County, Oklahoma.

Status: Planned.

Contractor: Various.

Completion: January 1, 1958.

- **Piedmont Gas Co., Hickory, N. C. (Parent is Carolina Natural Gas Corp.)**

Project: 78 miles of 2 to 8-in. extension off Trancontinental in North Carolina to serve Gaston, Lincoln, Catawba, Caldwell, and Burke counties.

Status: Has FPC approval.

- **Pioneer Gathering System, Inc.**

Project: 27 miles of 16-in. and 27 miles of 12-in. in Schleicher and Sutton counties, Texas.

Status: Filed for FPC approval.

Completion: July or August 1957.

- **Signal Oil & Gas Co.**

Project: 80 miles of gathering lines serving Tioga, N. D., gasoline plant; system being extended to Antelope, North Blue Buttes, and South Blue Buttes fields, McKenzie County, North Dakota.

Status: Under way.

Contractor: C. P. Bartley & Son, Tioga, N. D.

Completion: October 1, 1957.

- **Southern California Edison Co.**

Project: 200-mile line from San Joaquin Valley gas fields to power plant at Redondo Beach, Calif.

Status: Under way.

Completion: 1957.

- **Southern California Gas Co. and Southern Counties Gas Co. of California.**

Project: 241 miles of 30-in. from the outskirts of Los Angeles to Topock on the Arizona-California border.

Status: Under way.

Contractor: R. H. Fulton & Co., spread offices at Palmdale and Barstow, Calif.

Completion: June 30, 1957.

Project: 4 miles of 30-in. from Los Angeles River to Victoria Station at Los Angeles.

Status: Planned.

Completion: July 30, 1957.

- **Southern Natural Gas Co.**

Project: 10 miles of 8-in. laterals in Napoleonville Field and Fort Jackson Field, La.

Status: Has FPC approval.

Completion: December 1, 1957.

Pipeline Patrol

Project: 32 miles of 6-in. from Chandeleur Sound area, Breton Island, La.; 7 miles of 8-in. and 5 miles of 10-in. from Main Pass area to Olga, La.; 9 miles of 8-in. from Bastian Bay Field to Fort Jackson Field; 7 miles of 8-in. laterals in Manila Village Field.

Status: Plan to apply for FPC permit.

Completion: December 1, 1957.

• **Spokane Natural Gas Co.**

Project: 400 miles of 1 through 24-in. distribution system at Spokane.

Status: Under way.

Contractor: **Hallmac Construction Co.**; V. L. Williams, spread superintendent, office at Spokane.

Completion: 1957.

• **Tennessee Gas Transmission Co.**

Project: 221 miles of 30-in., 101 miles of 26-in., and 10 miles of 24-in. looping from Portland, Tenn., to Greenup, Ky.; from Morehead, Ky., to Catlettsburg, Ky.; from Catlettsburg to Broad Run, W. Va.; from New Wilmington, Pa., to Mercer, Pa.; and from New Castle, Pa., to near Pittsburgh, Pa.

Status: Pending FPC approval.

Project: 51 miles of 26-in., 51 miles of 20-in., and 17 miles of 12-in. gathering lines from Kinder, La., to offshore fields in Gulf of Mexico.

Status: Has temporary FPC approval.

Project: 577 miles of 30-in. from Mississippi River delta area south of New Orleans to Portland, Tenn.

Status: Pending FPC approval.

Project: 76 miles of 24-in. between Coudersport, Pa., and Hamburg, N. Y.

Status: Pending FPC approval.

• **Texas Eastern Transmission Corp.**

Project: 422 miles of 30-in. from near McAllen to Beaumont, Tex., to move imported Mexican gas; 45 miles of 24-in. laterals from McAllen to Provident City, Tex., 77 miles of 30-in. looping between Kosciusko, Miss., and Uniontown, Pa.; 147 miles of supply and sales laterals.

Status: Under way.

Contractor: **Houston Contracting Co.** has 121 miles of 30-in. between Angleton and Vidor, Tex. **H. C. Price Co.** has 70 miles of 30-in. **H. B. Zachry Co.** has 201 miles of 30-in. starting near McAllen and running northeast to near Angleton, Tex. **Grayco Constructors, Inc.** has 45 miles of 24-in. laterals from Blessing to Provident City. **Western Pipe Line, Inc.**, Austin, has 30-in. crossings at Nueces, Lavaca, and Carancahua bays. **Missouri Valley Dredging Co.**, Omaha, has crossings at Hinds and Guadalupe bays. **Altgelt Construction Co., Inc.**, has 100 miles of 3, 4, 6, 8-in. gathering lines in the Corpus Christi area.

Project: 17 miles of 8-in. and 3 miles of 6-in. from its 20-in. Baytown-Hankamer line to Alco-Mag field in Harris County, Texas.

Status: Has FPC approval.

Project: 97 miles of 30-in. loops between Kosciusko, Miss., and Uniontown, Pa., and 40 miles of new lateral supply lines.

Status: Filed for FPC permit March 15, 1957.

Completion: September 1, 1957.

Project: 667 miles of 30-in. from Kosciusko, Miss., to Uniontown, Pa.

Contractors: **H. C. Price Co.** has 64 miles from Barton, Ala., to Mt. Pleasant, Tenn., 51 miles from Mt. Pleasant to Gladevile, Tenn., 52 miles from Gladeville to Tompkinsville, Ky., 68 miles from Tompkinsville to Danville, Ky., 63 miles from Danville to Owingsville, 46 miles from Owingsville to Wheelersburg, Ohio. (Four spreads will be used). **Williams Brothers Co.** has 63 miles from Egypt, Miss., to Barton, Ala., 64 miles from Berne, Ohio, to Uniontown, Pa. **Houston Contracting Co.** has 80 miles from Kosciusko, Miss., to Egypt, Miss., 57 miles from Wheelersburg to Athens, Ohio, 61 miles from Athens to Berne, Ohio.

Completion: Fall 1957.

• **Texas Illinois Natural Gas Pipeline Co.**

Project: 10 miles of 36-in. to loop existing single 30-in. near Joliet, Ill.

Status: Has FPC approval.

• **Transcontinental Gas Pipe Line Corp.**

Project: 172 miles of 36-in., 68 miles of 30-in., 162 miles of 24-in., and 64 miles of smaller diameter pipe to loop main line from Texas to New Jersey.

Status: Work in North Carolina to start late May 1957.

Contractor: **Western Construction Co.** has 65 miles of 36-in. and 45 miles of 30-in. at scattered spots along the system in South Carolina, North Carolina, Pennsylvania, and Virginia. Western will start work in North Carolina, spread office at Winston-Salem.

Completion: Total project to be completed December 1957.

Project: 110 miles of 36-in. 16 miles of 30-in., and 13 miles of 24-in. looping in S. Car., Ga., Ala., Miss., and La.

Status: To start May 15, 1957.

Contractor: **Sharman, Allen, Gay & Taylor, Inc.**

Completion: November 1957.

Project: 29 miles of 16-in. lateral off the coast of Cameron Parish, La., and extending to company's existing system near Lake Charles.

Status: To start about June 1, 1957.

• **United Gas Pipe Line Co.**

Project: 40 miles of 8-in. from Baldwin County, Alabama, to Container Corp.'s plant.

Status: Has FPC permit.

Canadian Crude-Oil Pipelines

• **Act Oils, Ltd.** (subsidiary of Canada Southern Petroleums, Ltd.)

Project: A 450-mile line from the Peace River region of northern B. C. to tidewater at Bella Coola, B. C.

Status: Request has been made for permit from the B. C. government.

• **B-A Alberta Pipe Line, Ltd.**

Project: 35 miles of 8-in. to connect Drumheller field, Alberta, with existing lines running to Edmonton.

Status: Pending approval.

• **Gibson Crude Oil Purchasing Co., Ltd.**

Project: 19 miles of 6-in. from the Bellshill Lake oil field, Northeastern Alta., to tie in with Interprovincial Pipe Line's pump station near Hardisty, plus 3 miles of lateral lines.

Status: To start as soon as weather permits.

Contractor: **Hutchison Construction, Ltd.**, of Leduc, Alta., has construction contract. **Petrol-Structors, Ltd.**, of Calgary, are designing and supervising construction.

Completion: Late June, 1957.

• **Interprovincial Pipe Line Co.**

Project: 156 miles of 20-in. to extend present line from Sarnia to Port Credit, Ont.

Status: To start May 1957.

Contractor: **Somerville Construction Co.** has 90 miles; **Majestic Contractors, Ltd.**, has 66 miles, Earl Saulsman, spread superintendent, office at Galt.

Completion: September 1, 1957.

Project: 33 miles of 24-in. from Kendal to Peebles, Sask.

Status: To start June 1, 1957.

Contractor: **Fulton Banister, Ltd.**, John O'Rourke, superintendent.

Completion: July 31, 1957.

Project: 79 miles of 26-in. from Clearbrook, Minn., to Superior, Wis.

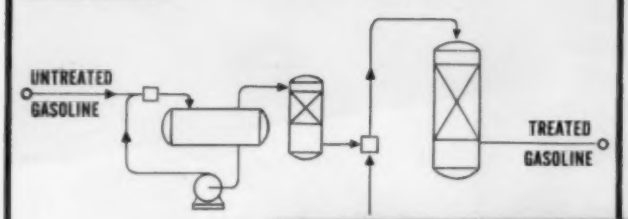
Status: To start June 1, 1957.

Contractor: **R. H. Fulton & Co.**

Completion: August 31, 1957.

• **Pembina Pipe Line, Ltd.**

TC SWEETENING



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Pipeline Patrol

Project: 100 miles of 3 to 12-in. gathering line in Pembina oil field.

Contractor: **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., T. Childress, spread superintendent, office at Drayton Valley, Alta.

Completion: November 1, 1957.

Project: 32 miles of 16-in. from Calmar to Edmonton, Alta.

Status: Under way.

Contractor: **Universal Pipe Lines, Ltd.**, subsidiary of Mannix, Ltd., Otis Hare, spread superintendent, office at Calgary, Alta.

Completion: July 1, 1957.

• **Rangeland Pipe Line Co.**

Project: 48 miles of 12-in. between Sundre and the Sylvan Lake in south-central Alberta.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.**

Completion: June 15, 1957.

• **Royalite Oil Co., Ltd.**

Project: 250 miles of line to move oil from the Athabasca oil sands of northeastern Alberta to Edmonton.

Status: Long range plans.

Completion: 1960.

• **Trans Mountain Oil Pipe Line Co.**

Project: 100 miles of 30-in. loops: 50 miles east of Kamloops, B. C., and 50 miles west of Edson, Alta.

Status: Under way.

Contractor: **Marine Pipeline & Dredging, Ltd.**, has Thompson River crossing, B. C., J. H. McCartney, spread superintendent, office at Kamloops, B. C. **R. A. Conyes Construction Co.** has the 50 miles east of Kamloops; **Dutton-Williams Brothers, Ltd.** has the other 50 miles.

Completion: River crossing will be done by June 15, 1957; remainder by July 31, 1957.

• **Westspur Pipe Line Co.**

Project: 20 miles of 12-in. from Alida in southeastern Saskatchewan, to the Carnduff-Glen Ewen area to tap Cantal, Hastings, Florence, Carnduff, and Glen-Ewen fields; 34 miles of 4, 6, 8-in. gathering lines.

Status: Has requested permit from Board of Transport Commissioners.

Contractor: **Majestic Contractors, Ltd.**, Jeff Minter, spread superintendent, office at Estevan, Sask.

Completion: No date set.

Project: 75 miles of 16-in. from Steelman, Sask., to Cramer, Man., Canada.

Status: Work starts May 1957.

Completion: July 30, 1957.

Canadian Products Pipelines

• **Hydrocarbons Pipeline Co.** (Subsidiary of Canadian Hydrocarbons).

Project: 800 miles of 6 and 8-in. L.P.G line from near Edmonton, Alta., to Port William, Ont.

Status: Has permit from Parliament of Canada. If approved by Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board, work will start in 1957.

Construction consultants: **Dutton-Williams Brothers, Ltd.**, Calgary, and **A. D. Little & Co.**, Boston.

Canadian Gas Pipelines

• **Alberta Gas Trunk Line Co., Ltd.**

Project: 637 miles of 34 to 16-in. gathering lines in Alberta.

Contractor: **Dutton-Williams Brothers, Ltd.** has preliminary studies, design and management-engineering. **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., jointly with **Marine Pipeline & Dredging Co.**, has crossing of Red Deer River near Cavendish, Alta., J. Hysuick, spread superintendent, office at Empress. **Fulton Banister, Ltd.**, has 17 miles of 34-in. west from Trans-Canada pipeline origin near Burstall, Sask., to near Cavendish, Alta.; 100 miles of 18-in. north to Bindloss and Provost fields.

Status: River crossing completed. Total project to be completed in 1960.

Status: To start May 1957.

Completion: Summer 1957.

• **Inland Natural Gas Co., Ltd.**

Project: 304 miles of mainline and 25 miles of laterals from Savona to Nelson, B. C.: 150 miles of 12-in.; 112 miles of 10-in.; 67 miles of 6-in. Also will build 400 miles of distribution piping in 31 towns.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.**; Pat Campbell, project manager, office at Penticton.

Completion: October 1, 1957.

• **Plains-Western Gas & Electric.**

Project: 16 miles of 10-in. from the Trans-Canada Pipe Line to Brandon, Manitoba.

Contractor: **Banister Construction, Ltd.**, George Caron, superintendent.

Completion: 1957.

• **Saskatchewan Power Corp.**

Project: 13 miles of 4-in. lateral to town of Kerrobert, and 10 miles of 6-in. lateral to Kindersley Power Plant, Sask.

Status: Planned.

Contractor: **Banister Construction, Ltd.**

Completion: July 15, 1957.

Project: 300 miles of 1 to 20-in. distribution lines at Regina, Sask.

Status: Planned.

Contractor: **S. E. Construction (Alberta), Ltd.**, and **Pacific Pipeline Construction (Alberta), Ltd.**, jointly.

• **Trans-Canada Pipe Lines, Ltd.**

Project: 574 miles of 34-in. from the Alberta-Saskatchewan border to Winnipeg. (First

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Pipeline Patrol

part of 2,250-mile line from Alberta to Toronto and Montreal.)

Status: Under way.

Contractors: **Majestic Contractors, Ltd.** (104 miles from Burstall to Stewart Valley, Sask., R. L. Leonard, spread supt., office at Cabri., **Canadian Bechtel, Ltd.** (110 miles from Swift Current to Moose Jaw, Sask., J. L. Work, general supt., office at Moose Jaw, and 54 miles from Portage la Prairie to Winnipeg); **Universal Pipe Line, Ltd.,** subsidiary of **Mannix, Ltd.,** (90 miles from Moose Jaw to Welseley, spread superintendent, Otis Hare, office at Regina, Saskatchewan); **Dutton-Williams Brothers, Ltd.** (97 miles from Deveren to Moosomin, under way, to complete August 1957). **Price-Poole of Canada, Ltd.,** has 100 miles from Miniota to near McGregor to start in 1957. **Marine Pipeline & Dredging, Ltd.** has 30-in. Red River and Assiniboine crossing in Manitoba.

Completion: Red River crossing to be completed May 31. Assiniboine River crossing completed.

Project: 82 miles of 30-in. from near Winnipeg to the Ontario-Manitoba border.

Status: Under way.

Contractor: **Majestic Contractors, Ltd.,** K. B. Killingsworth, spread superintendent, office at Ste. Anne, Man.

Completion: October 15, 1957.

• **Union Gas Co. of Canada, Ltd.**

Project: 142 miles of 26-in. from Dawn Township to Hamilton, Ontario, plus 55 miles of 6 to 20-in. laterals, and 317 miles of 2 to 12-in. distribution lines.

Status: Planned.

Completion: November 30, 1957.

Project: 17 miles of 8 to 20-in. storage lines in Dawn Township, Ontario.

Status: Planned.

Completion: August 1957.

• **Westcoast Transmission Co., Ltd.**

Project: 650 miles of 30-in. from Peace River area, Canada, to Sumas, Wash.

Status: Under way. About two-thirds completed.

Contractors: **Dutton-Williams Brothers, Ltd.,** has 120 miles from Taylor, B. C., to Azouzetta Lake, completed; **Universal Pipe Lines, Ltd.,** subsidiary of **Mannix, Ltd.,** has 110 miles between Huntingdon and Kingsvalle, B. C., F. L. Byers, spread superintendent, office at Hops, B. C.; **Canadian Bechtel, Ltd.,** has 210 miles from Alexandria to Pine Pass, B. C., H. F. (Hank) Mogg, spread man, office at Quesnel, B. C.; **R. A. Conyes Construction Co.,** has 210 miles; **River Construction Corp., Ltd.,** has under way 150 miles of gathering lines in northern Alberta and British Columbia; **Marine Pipeline & Dredging, Ltd.,** has Fraser and Peace River crossings, Waldo Trim, spread superintendent, offices at Fort Saint John and Hope, B. C.

Completion: Dutton-Williams section completed. R. A. Conyes section and Canadian Bechtel section to be completed September 1957. Marine Pipeline work to be completed June 30, 1957. Universal Pipe Lines, Ltd. will complete work September 1, 1957.

Project: 174 miles of 30-in. from Savanna Creek area to the Canadian-Idaho border.

Status: Proposed.

Foreign Crude-Oil Pipelines

• **Bolivian Gulf Oil Corp.**

Project: 160 miles of 10-in. and 43 miles of 8-in. from Sicascia to Arica on the Chilean coast.

Status: Awaiting pipe.

Contractor: **Williams Brothers Co.**

Completion: December 1957.

• **Caltex**

Project: 30 miles of 30-in. from Duri field in Sumatra to Dumai where a deepwater terminal will be built. Line will be extended 35 miles of Minas field later.

Status: Planned.

Completion: Duri-Dumai line to be finished in 1959; extension to Minas later.

• **Colombian Petroleum Co.**

Project: 42 miles of 6-in. from Tibu field to Rio de Oro in Colombia.

Status: Under way.

• **C.R.E.P.S., Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (SN Repal), and Cie. Francaise des Petroles Algerie**

Project: Two 10-in. lines from Hassi Messaoud and Edjele, Algeria to the railhead at Touggourt.

Status: Planned.

Completion: 1958.

• **Creole Petroleum Corp.**

Project: 87 miles of 30-in. from Temblador field to Caripito in Venezuela.

Status: Planned.

Completion: 1959.

Project: 9 miles of 26-in. from Ule to La Salina in Venezuela.

Status: Planned.

Completion: Late 1957.

• **Deutsche-Shell A.G.**

Project: 120 miles of 20, 24-in. from Marseilles, France, to Rotterdam, Germany, to tap the proposed 700 mile trans-Europe line being considered by the Royal Dutch-Shell Group.

Status: Planned.

Completion: 1960.

• **Iraq Petroleum Co.**

Project: About 600 miles of up to 40-in. from Kirkuk field through Iraq and Turkey

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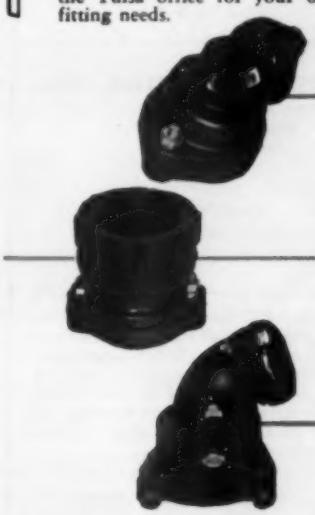

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Pipeline Patrol

to the Turkish port of Iskenderun on the Mediterranean sea.

Status: Proposed. Survey completed.

• **Mene Grande Oil Co.**

Project: 97 miles of 30-in. from fields in Eastern Venezuela to Puerto La Cruz.

Status: Under way.

Contractor: **Fulghum Contracting Corp.** has 22 miles between Oficina and Anaco.

Completion: First quarter 1958.

• **North-West Oil Pipelines Co.** (newly formed by six West German refiners, headed by affiliates of Standard Oil Co. (N.J.), and British Petroleum Co., Ltd.)

Project: 210-mile line from the refining centers in the industrial Ruhr area of West Germany to Wilhelmshaven.

Status: Planned.

Completion: 1959.

• **Royal Dutch-Shell**

Project: 700-mile line across Europe from the Mediterranean to the North Sea, running through Eastern France, Luxembourg West Germany, and Netherlands, and Belgium. Main trunk to be 30-in.

Status: Company is considering project together with several other companies.

• **Sinclair Oil Corp. and Socony Mobil Oil Co.**

Project: 211 miles of 20-in. from the Silvestre field in Barinas, Venezuela, to Puerto Cabello on Caribbean Sea.

Status: Under way.

Contractor: **Williams Brothers Sudamericano, Ltd.**

Completion: July 1957.

• **Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie**

Project: Line in Sahara Desert area to move oil from Hassi Massaoud field. Two routes possible: 200 miles from the field northwest to Laghouat; 260 miles from the field to the north and slightly east to Biskra.

Status: Under study.

• **Yacimientos Petroliferos Fiscales** (Argentina)

Project: 932 miles of 12-in. from Campo Duran to San Lorenzo.

Status: Under way.

Contractor: **TECHINT** (Compania Tecnica Internacional), Buenos Aires, has 90 miles.

Foreign Products Pipelines

• **Empresa Nacional de Petroleos** (Government of Chile) and **Cia. de Petroleos de Chile (Copec), et al.**

Project: 75 miles of 10-in. from Chile's coastal refinery at Concon to Santiago.

Status: Planned.

Contractor: **Williams Brothers** has design and engineering contract.

Completion: Design plans will be completed August 1, 1957. No date for construction has been set.

• **Israeli Government**

Project: A 6-in. line from the Haifa refinery to Tel Aviv.

Completion: Late 1957.

• **Yacimientos Petroliferos Fiscales** (Argentina).

Project: 497 miles from Mendoza to Buenos Aires.

Status: Proposed.

Foreign Natural-Gas Pipelines

• **Attock Oil Co.**

Project: 60 miles of line from Dhulian field to Rawalpindi in West Pakistan.

Status: Planned.

• **Cia. Shell de Venezuela.**

Project: 177 miles of 20-in. from La Paz field in the Maracaibo district, to the Cardon refinery on Paraguana Peninsula, to fuel refinery furnaces.

Status: Under way.

Contractor: **Williams Brothers Co.**

Completion: 1957.

• **Gaz de France**

Project: 550 miles of 16 to 24-in. from Lacq field, southwestern France, to Paris, plus a 10-in. lateral to Nantes and 12 to 16-in. laterals to Lyons, making a 1,000-mile system.

Status: Right-of-way work under way.

Contractor: Being handled by French contractors.

Completion: First stage in 1958; complete system in 1960.

• **Petroleos Mexicanos**

Project: 130 miles of 22-in. to parallel a 14-in. line from Reynosa to Monterrey in northern Mexico.

• **Sui Gas Transmission Co.**

Project: 217 miles of 16-in. from Sui gas field to Moultan, Pakistan.

Status: Under way; to be extended later to Lahore with branches at Kot Addu, Jhang Magiana, and Montgomery.

Contractors: **Pakistan Constructors,** a joint company of **Morrison-Knudsen** of **Boise, Idaho,** and **William Press, Ltd.,** of **London.**

Project: 145-mile line from Sylhet to Dacca, East Pakistan.

Status: Under consideration. If approved construction could start December 1958.

• **Technical Office of Hydrocarbon, Ministry of Mines and Petroleum, Government of Venezuela.**

Project: 207 miles of 26-in. from Anaco fields to Caracas.

Status: Under way.

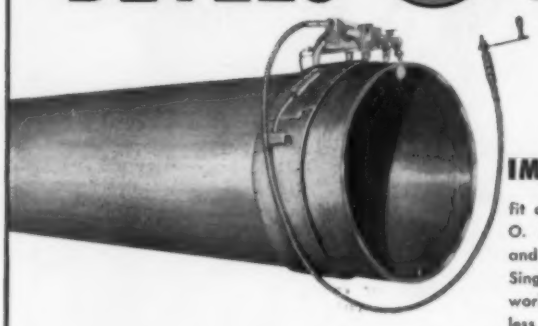
Contractor: **Fulghum Contracting Corp.** will be consultants; **Petrogas, S. A.** will engineer and construct the line.

Completion: Spring 1959.

Status: Under way.

BEVELS 6" PIPE

BEVELS 48" PIPE



C-R-C IMCO BEVELERS

fit all pipe sizes 6" to 48" O. D., cut perfect bevels, and out-of-round pipe, too. Single lightweight unit does work of several, costs you less to buy and use.

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IN CANADA: Canadian Equipment Sales & Service Co.
7310 99th St., Edmonton, Alberta, Canada

ONE BEVELING KIT FOR ALL YOUR JOBS!

The CRC IMCO Pipe Beveling Kit contains a complete range of bands for beveling a variety of pipe sizes. With this convenient selection of sizes, the operator need only make one trip to handle all pipe beveling requirements including back beveling. The sturdy steel case and number of bands are optional.

mail to:

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SEND US LITERATURE ON C-R-C IMCO PIPE BEVELERS

"Pace Setter" For The Oil Patch . . .

The BS&B Model GDH COLD-FRAC SYSTEM With Hydrate Inhibitor

BS&B "COLD-FRAC" Units with hydrate inhibitor (Model GDH) were especially developed for gas-condensate wells having an available pressure drop of 500 psi or greater, where gas dehydration and hydrocarbon dew point control present a problem.

The outstandingly successful performance of these Model GDH units in producing a maximum volume of condensate, and in dehydrating the processed gas to pipeline specifications, is due in part to the fact that each unit is specifically engineered to fit the conditions at the lease where it is to be operated.

If you are not now using a BS&B Model GDH "COLD-FRAC" Unit on your lease, why not talk it over with your BS&B Man? Or, send us the following information upon which to base our recommendation for a unit to efficiently handle your lease production:

1. Minimum inlet wellstream pressure and maximum inlet wellstream temperature.
2. Maximum wellstream flow rate.
3. A Podbielniak analysis of the wellstream (if available).
4. Liquid-Gas Ratio from welltest with test conditions.
5. Gas Transmission line pressure.
6. Desired Vapor pressure of stabilized condensate and storage pressure.
7. Presence of paraffin (cloud point of liquid from high pressure wellstream at wellhead flowing pressure and temperature).
8. Volume of salt water produced.

Basic Components of the Model GDH Unit to Separate End Products Include:

1. Inlet Liquid Knockout
2. Secondary Liquid Knockout
3. Cold Liquid-Gas Separator With Inlet Choke
4. Stabilizer

Auxiliary Components Include:

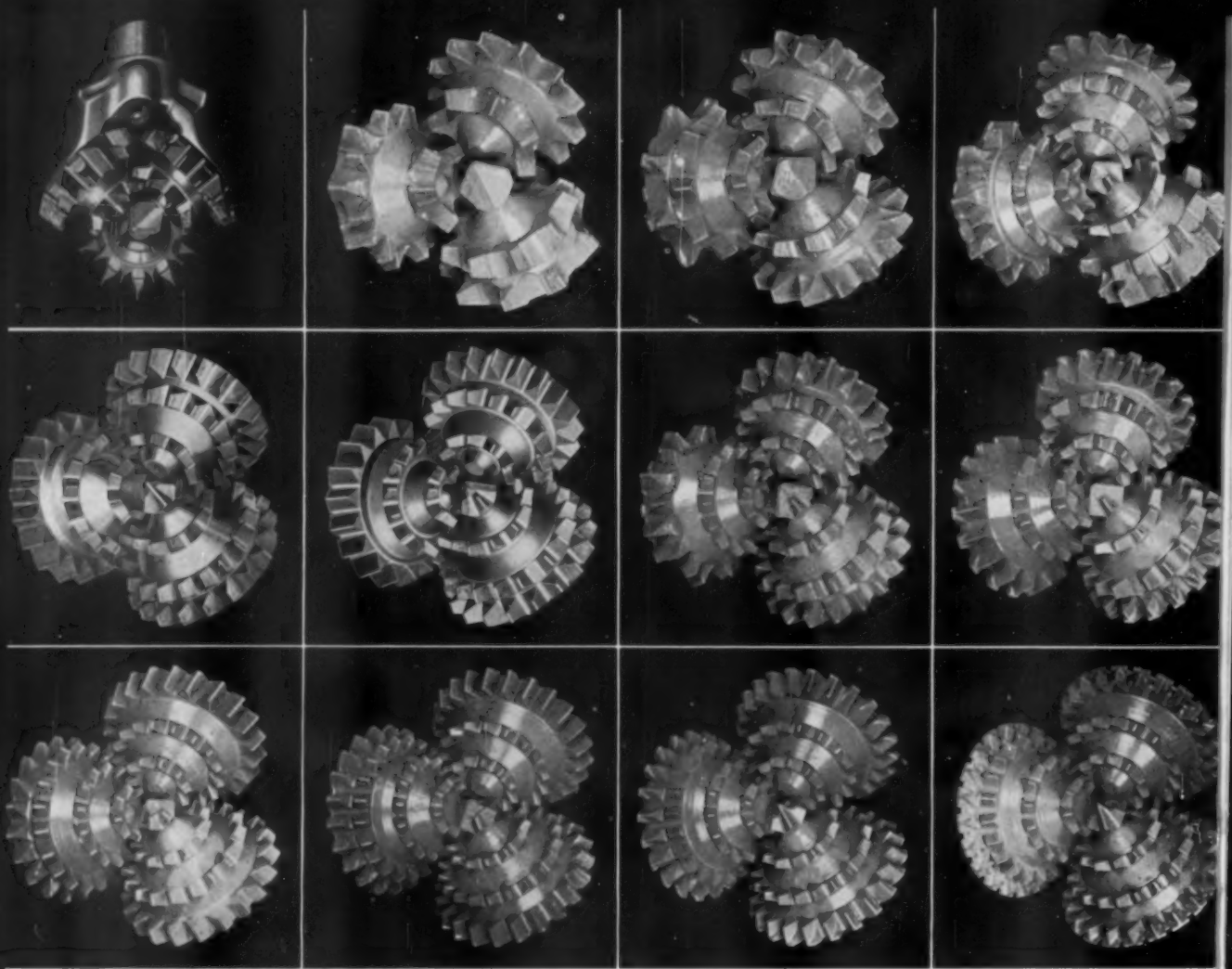
1. Wellstream Cooler
2. Product Cooler
3. Glycol Pump
4. Glycol Regenerator
5. Glycol-Oil Separator
6. Hydrate Catcher With Pressure Controller for Safety Shut-In

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-A5

P. O. Box 1714 Oklahoma City, Oklahoma



Record Breakers every one of them!

Every one of these bits have played an important part in Security's rapid climb from 5th to 2nd place in rock bit sales. And each one of them has been setting a record of its own in footage drilled per bit and rate of penetration.

For example, Security S3J bits (upper left corner) were used recently to drill the fastest-drilled medium depth vertical hole in the Seria field of Borneo. Five Security bits were used to drill from 1505′ to 5556′, *an average of 810′ per bit.* In Oklahoma, Security H7 bits (bottom row, 2nd from left) punched through hard Arbuckle limestone for toolpusher Page Arnall of Riceland Corporation to the tune of 53.7′ per bit, an average of 4′ more hole than competitive bits.

Bit records like these are being recorded every day by progressive toolpushers the world over. But records in themselves are not important, rather the lower cost per foot hole drilled by Security bits. You'll know this difference when costs are posted on your balance sheet, the only record that really counts.

If you haven't already, why not give Security a chance to show up on your next record. . . .You'll be glad you did.

Security

ENGINEERING DIVISION

DALLAS, TEXAS • WHITTIER, CALIFORNIA

EXPORT OFFICE: P. O. BOX 13647, DALLAS, TEXAS

Among the

Drilling Contractors

Citronelle Contractors Drill 1,000,000 Ft. of Hole

A REVIEW of development at Citronelle, in northern Mobile County, Alabama, reveals that 15 contractors have had rigs running in the immediate area at least part of its 2½ years of productive life to date.

They have drilled 89 wells, including those now testing and 6 dry holes. Two of the latter have been long stepouts, one an old hole deepened.

Wells drilled aggregated 1,010,701 ft. of hole, averaging 11,356 ft. per well. The total is based on the final total depths of the wells, and excludes any sidetracking and redrilling.

They drilled for 11 different companies or operating groups. Nine of these now have production in the field. They include several of the contractors who drilled for their own accounts, or as participants in the operating groups.

Zach Brooks Drilling Co., El Dorado, Ark., heads the list of contractors in number of wells drilled. Its 28 wells to date include 25 drilled for its own account as a participant in an operating group, and 3 on a contract basis for other operators.

Brooks drilled the discovery well, in which it held 50 per cent interest with Gulf Refining Co. and Everett Eaves, of Shreveport, as joint owners. Its completion in Rodessa and Sligo sands gave Alabama its first Lower Cretaceous production and opened what has proved to be the state's most important field to date.

Discovery well was completed officially October 10, 1955. Over-all time from spudding date (July 12, 1955) to final completion was 90 days. Time on some of the more recent wells has been reduced to less than 40 days, rig on and off.

From 15 to 18 rigs were running at Citronelle during the height of its development in the summer and early autumn of 1956. Seven contractors still are in the field with 1 rig each.

Companies which have, or have had, rigs in the area since its discovery are:

Company—	Wells drilled	Total footage
Zack Brooks Drilling Co.	28	321,267
Trans-Tex Drilling Co.	13	147,404
Dixilyn Drilling Co.	12	137,534
Drilling & Exploration Co.	11	126,758
Gulf Coast Drilling & Exploration Co.	9	103,008
General American-Guiberson-Beatty	4	45,221
Justiss-Mears Drilling Co.	2	22,926
Cook Drilling Co.	2	22,960
D. W. Skelton	2	23,006
Dorris Ballew, Inc.	1	11,702
Index Drilling Co.	1	11,445
Tri-State Drilling Co.	1	11,425
Jett Drilling Co.	1	11,500
San Juan Drilling Co.	1	11,593
Lyle Cashion	1	*2,952
Total	89	1,010,701

*Old hole deepened from 9,100 ft. to 12,052 ft.

Zapata Drilling Co., Midland, Tex., is keeping a rig going for California Co. in extension exploration south of the latter's oil and gas discovery wells in Blocks 40 and 41, Main Pass area, in Breton Sound off the east side of Plaquemines Parish, Louisiana. Rig now is on a 9,000-ft. well being drilled in Block 58. Location has been staked for a 7,500-ft. test 8,300 ft. northeast, in Block 59.

Clegg & Hunt, Houston, will drill a 14,500-ft. exploratory test 2 miles southwest of the Mosquito Bay area, in the tidal marshes of southwestern Terrebonne Parish, southeastern Louisiana. It is Pan American Petroleum Corp. contract job at 1 Nelson, in 3-21s-12e.

Longhorn Drilling Co., Three Rivers, Tex., has contract for an 8,500-ft. test to be drilled for Western Natural Gas Co. at a wildcat location 4½ miles northeast of Lamar, on the east shore of Aransas Bay, Aransas County, in Texas' central coastal area. Location (29 St. Charles), in the R. D. Blossman Survey, is 3 miles southwest of St. Charles field.

Del Mar Drilling Co., Corpus Christi, has a new wildcat operation 4 miles northwest of Corpus Christi, in the Saxet area, Nueces County, Texas. It is a 7,100-ft. test for Tri-Mark Oil Co. at 1 Driscoll Estate, in the Rincon del Oso Grant, W. S. McGregor Survey 583.

Owen Drilling Co., Lafayette, La., is to drill a 12,000-ft. test 1¼ miles northeast of Ellis field, 6 miles north-

Protects threads—prevents galling and seizing—gives tight seals—permits easy separation—lengthens drill string life. These are reasons why 'Bestolife Lead Seal Tool Joint and Casing Compound has been the standard of the oil country for over twenty-five years. Unconditionally guaranteed.

Packed in 1¼, 5, 20 and 50 lb. containers. Sold by leading supply houses the world over.

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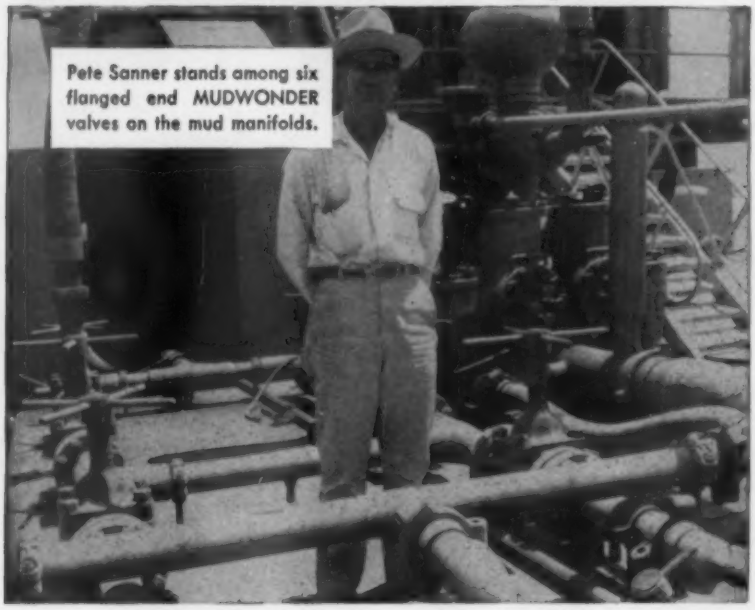
Tips on Mud Valves for Toolpushers...



Pete Sanner stands among six flanged end MUDWONDER valves on the mud manifolds.

New Oil Rig Equipped With MUDWONDER For Substantial Operational Savings

by Pete Sanner, Toolpusher, Rig #77
Nichols Drilling, Inc., Duncan, Oklahoma

MUD valve problems? We don't expect any on our new Rig #77. It is 100% equipped with Rockwell-Built MUDWONDER mud valves.

This is not Nichols' first experience with the MUDWONDER. Our company has been using them altogether for some time. Our records verified reports we got from crews in West Texas, the Gulf Coast, and Oklahoma. Everyone said the MUDWONDER is easier to operate, requires much less maintenance, holds pressure drop tight, and has longer service life.

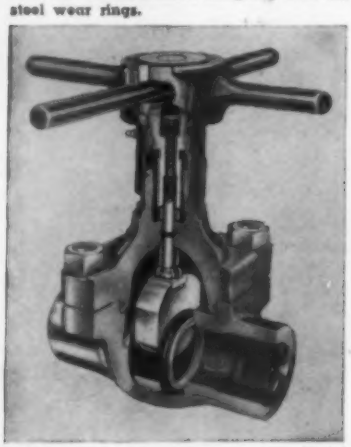
So, when we ordered our new rig, we specified MUDWONDER mud valves throughout. These valves cost the same as other commonly used mud valves, but we will realize substantial savings on operating costs. In fact, the MUDWONDERS have not cost one cent in downtime, labor, or parts during our first six months drilling.

But, if maintenance or part replacement is required, it can be done without special tools while the crew makes a connection. The one-piece MUDWONDER body keeps mudlines intact at all times. Downtime can be avoided.

Crewmen, too, highly recommend MUDWONDER valves as a solution for troublesome mud valve problems. MUDWONDER valves are built in 2", 3", and 4" sizes with screwed or flanged ends for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test).

See favorite oil field supply store for complete information, or write Edward Valves, Inc., subsidiary of Rockwell Manufacturing Company, East Chicago, Ind.

MUDWONDER cut-away view shows the double thread construction, separated stainless stem and chromed gate with "T" slot connection and the one-piece seat insert with the Buna-N molded integrally over the steel wear rings.



(Advertisement)

west of Crowley, in Acadia Parish, southern Louisiana. It is a contract operation for J. P. Owens, of the contracting company, and Midwest Oil Corp. Location is on the Stokes estate lease, in 7-9s-1e.

Vasser & Brown, Inc., Natchez, Miss., is to drill an 8,600-ft. test on the west side of North Tepetate field, in northwestern Acadia Parish, Coastal Louisiana. It is a contract job for E. Saunders Alpaugh, of New Orleans, at 1 Acadia Parish School Board, in 16-7s-2w.

Hummingbird Drilling Co., Inc., Magnolia, Ark., is under way on a 5,350-ft. Pettet test a mile north of Emerson, in Columbia County, southern Arkansas. It is drilling for M & N Operating Co., of Natchez, Miss. Location is at 1 Mullins, in 5-19s-20w.

Jack Halbert Drilling Co., Kilgore, Tex., is drilling on a 5,800-ft. wildcat test 4 miles northeast of Palestine, in Central Anderson County, East Texas. It is a contract job for LaGorce Oil Co., of Fort Worth. Location is on the Reville lease, in the John Padon Survey. Woodbine is the objective.

Gibson Drilling Co., Kilgore, Tex., has a new wildcat operation 12 miles southwest of Athens, in southwestern Henderson County, East Texas. The test, 1 Kinabrew, in the Isaac Greeson Survey, is for the contractor's own account. It is scheduled to go to the Woodbine below 4,300 ft. Location is about 1½ miles north of production in the Cayuga area.

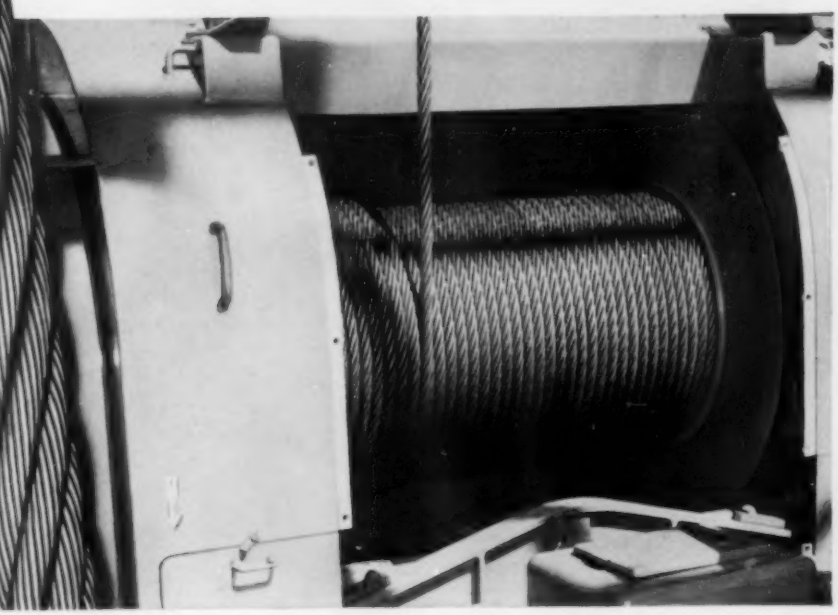
Pyramid Drilling Co., Alice, Tex., is on a 3,300-ft. job north of the Kreis area, 7 miles northeast of Freer, in Duval County, Southwest Texas. Operator is Cecil B. Burton, of Corpus Christi. Location is for Annie Kries Murphy, in the E. Mendez Survey.

Jett Drilling Co., Shreveport, is under contract to Midstates Oil Corp. for a rank wildcat test in Claiborne County, southwestern Mississippi. Location, at 1 Headley, in 12-12n-2e, is 2½ miles north of Port Gibson. It is 15 miles from nearest production. Plans call for a 9,900-ft. test.

Petersen Drilling Co., Shreveport, has taken a shallow contract in Adams County, southwestern Mississippi. Drilling is for Marlin Exploration, Inc., at 1 Miller et al, in 56-7n-1w. Location is about 2½ miles west of Cranfield field, east of Natchez. Planned depth is 3,800 ft.

New LAY-SET VHS+
Tailor-made Cut-off Practices =Longer Drilling Line Life

HAZARD LAY-SET VHS 15% Stronger



• Cost-conscious drilling operators are finding that they can get longer life from their rotary drilling lines if they will follow two simple steps: first, install a line of new, tougher, stronger LAY-SET **VHS**. Next, follow religiously a tailor-made cut-off program, developed especially for their particular drilling operation by their Hazard field representative.

Higher Safety Factor

New LAY-SET VHS (Very High Strength) is at least 15% stronger than Improved Plow Steel, the strongest grade formerly available. This means a factor of safety about 15% higher than with IPS lines. You get the same factor of safety with 10 lines of VHS that you would get with 12 lines of IPS.

Faster Drilling

This extra strength saves you time. With VHS you can drill deeper before increasing the number of parts of line...make round trips faster...and eliminate in many cases any necessity for buying new blocks or regrooving sheaves to use larger diameter lines for higher safety factor.

Resists Wear

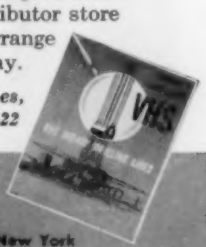
New LAY-SET VHS is tougher, too. It has greater abrasion resistance and higher resistance to peening. This means that you will get extra ton miles...longer wear...if you follow the right cut-off practices.

Tailor-made Cut-off Practice

Good cut-off practice varies from rig to rig and from drilling site to drilling site. Your Hazard field representative has the wide experience necessary to establish the best cut-off practices for your particular drilling operation.

For extra ton miles, get the expert services of your Hazard field representative. Your local Hazard distributor store personnel will be happy to arrange his early visit. Call them today.

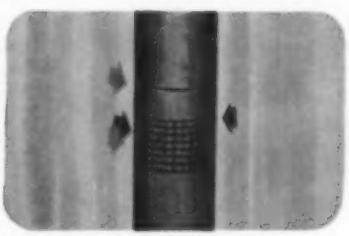
For further information on LAY-SET VHS drilling lines, write to the nearest Hazard office for Brochure DH-522



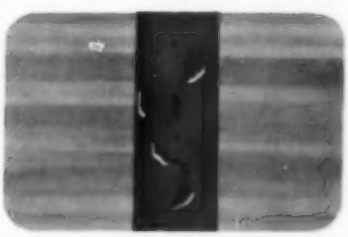
HAZARD WIRE ROPE DIVISION
American Chain & Cable Company, Inc.
Sales Offices in: Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles, New York Odessa, Tex., Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Bridgeport, Conn.
PLANTS IN WILKES-BARRE, PA., AND HOUSTON, TEXAS

M

When this happens to your drill pipe...be glad you're using Field Replaceable REED Super Shrink-Grip Tool Joints!



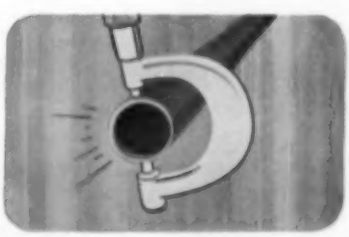
Notch Fatigue (Slip Wear)—Transverse notches, such as those caused by slip teeth can make even relatively new pipe fail. Crosswise notches and scars are natural stress raisers and are an open invitation to failure and fishing jobs.



Corrosion Fatigue—Corrosion fatigue is one of the most common causes of drill pipe failure. Pipe becomes pitted. Pits become stress raisers as pipe bends. Cracks develop. Joints deeply pitted are usually unsafe.

Crooked Pipe—Running pipe in compression, dropping pipe while pulling up or laying down joints, or careless handling during transportation can crook pipe. Crooked pipe is more likely to fail from fatigue, and accelerates wear on tool joints.

"Necked Down" Pipe—Using tongs on the body of the pipe or careless setting in the slips when tripping heavy strings can crush the pipe. Pulling too hard on stuck pipe will cause it to neck down.



Worn Pipe—The straightest pipe wears. Crooked pipe wears lopsided. Depth of well to be drilled, corrosion and other factors affect how hard pipe is stressed and, consequently, how thin it can be worn before it is dangerous to run.

Most operators have to retire some drill pipe with each well drilled . . .

any cut their loss in half by using

Field Replaceable Tool Joints

Drill pipe failures often occur when there are many thousand feet of good service life left in the tool joints. Why lose both? With Field Replaceable Reed Super Shrink-Grip tool joints, you can retire the pipe, remove the tool joints and apply them to new pipe right in the field with your own labor. There's no costly delay, no transportation or shopping expense, and most important . . . you don't lose your original investment in the tool joints which amounts to approximately 50 percent of the cost of your drill pipe-tool joint string.

This is just one of six sound reasons why Reed Super Shrink-Grip tool joints are *right for your rig regardless of location* . . . ask your Reed man!

REED ROLLER BIT COMPANY **HOUSTON 1, TEXAS**

Write or wire for complete information . . . or have your Reed man explain the economical and engineering advantages of Reed Tool Joints.

7008

the river that flows on wheels

More petroleum moves over Santa Fe than over any other railroad in the country

The river that flows on wheels is the 2,384,000,000 gallons of Petroleum that Santa Fe moves every year.

It's so large that it makes Santa Fe the No. 1 petroleum railroad in the country.

This flood tide of oil gives heat and power to farms, factories, military installations and homes all over the nation.

The tremendous demand for petroleum, in all its forms, poses special problems for Santa Fe. For it requires speed and service to keep that river flowing full force. Here are a few of the ways we get the job done:

We move empty tankers just as fast as full ones, so no vehicle will stand idle.

As new oil fields are opened up, we stand ready to serve them. And when new developments take place within the industry, we adapt ourselves to take care of them.

As an example, take liquefied petroleum gas. The demand for it has skyrocketed in the last 10 years, because with this "bottled gas" rural families can cook and heat with gas just like city people. And the railroads have made it possible for them to get it.

Santa Fe runs special LPG trains when the demand for this product requires it. In a year, these trains carry enough LPG to heat more than 500,000 homes from November through April.

This is just a part of the story of the dependable transportation service Santa Fe is providing to essential industries that contribute so much to the welfare of our country.

Santa Fe

Always on the move toward a better way

SANTA FE SYSTEM LINES

Serving the West and Southwest

SHOWCASE...

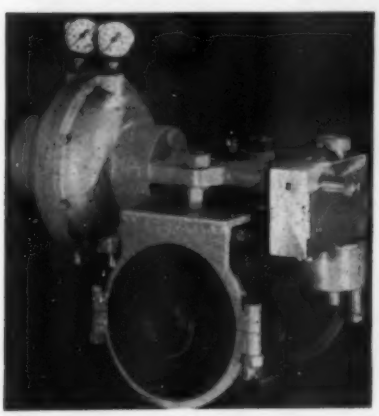
NEW EQUIPMENT

Four-Cylinder Tractor Has Five-Speed Transmission

Both mobility and speed are provided by this new 143-hp. rubber-tired Model D tractor. Paving, bridges, and rail tracks are unharmed by its 18 by 25.00 low-pressure rubber tires.

This feature combined with a top speed of nearly 20 m.p.h. permits it to travel from job to job under its own power, without hampering traffic. At work, the same abilities allows it to run quickly between scattered assignments.

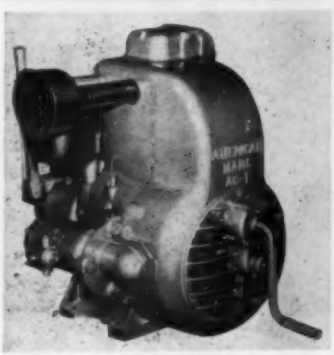
It employs a four-cylinder, 143-hp. diesel and a five-speed earthmover type of transmission, providing speeds from 2.2. to 19.3 m.p.h. And the planetary steering system permits turns while maintaining full power on all four drive wheels. **Write or call: LeTourneau-Westinghouse Co., Peoria, Ill., for details on Model D Tournatractor.**



Positioner Actuator Converts Plug Valves to Regulators

This new Bettis positioner actuator allows modulating control of plug valves. The positioner is a compact, ruggedly built instrument which is designed for attachment to standard Robotarm actuators.

Use of the positioner also makes possible conversion of plug valves into regulators or relief valves, the maker says. **Write or call: Bettis Corp., 620 South Sixty-Sixth Street, Houston, Tex., for details on Robotarm positioner.**



Air-Cooled 6½-Hp. Diesel Offers Variety of Uses

This Model AC-1 diesel engine is a 6½-hp., one-cylinder, air-cooled diesel that can be used for many applications including offshore drilling.

Its piston displacement is 34.8 cu. in., its bore and stroke are 3½ by 3⅝ in., and its compression ratio is 20 to 1. Weighing 220 lb., the engine is about 24½ in. long, 19½ in. wide, and 24 in. high.

The valve-in-head four-stroke-cycle

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

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Described in OIL AND GAS JOURNAL - Issue of **May 13, 1957**

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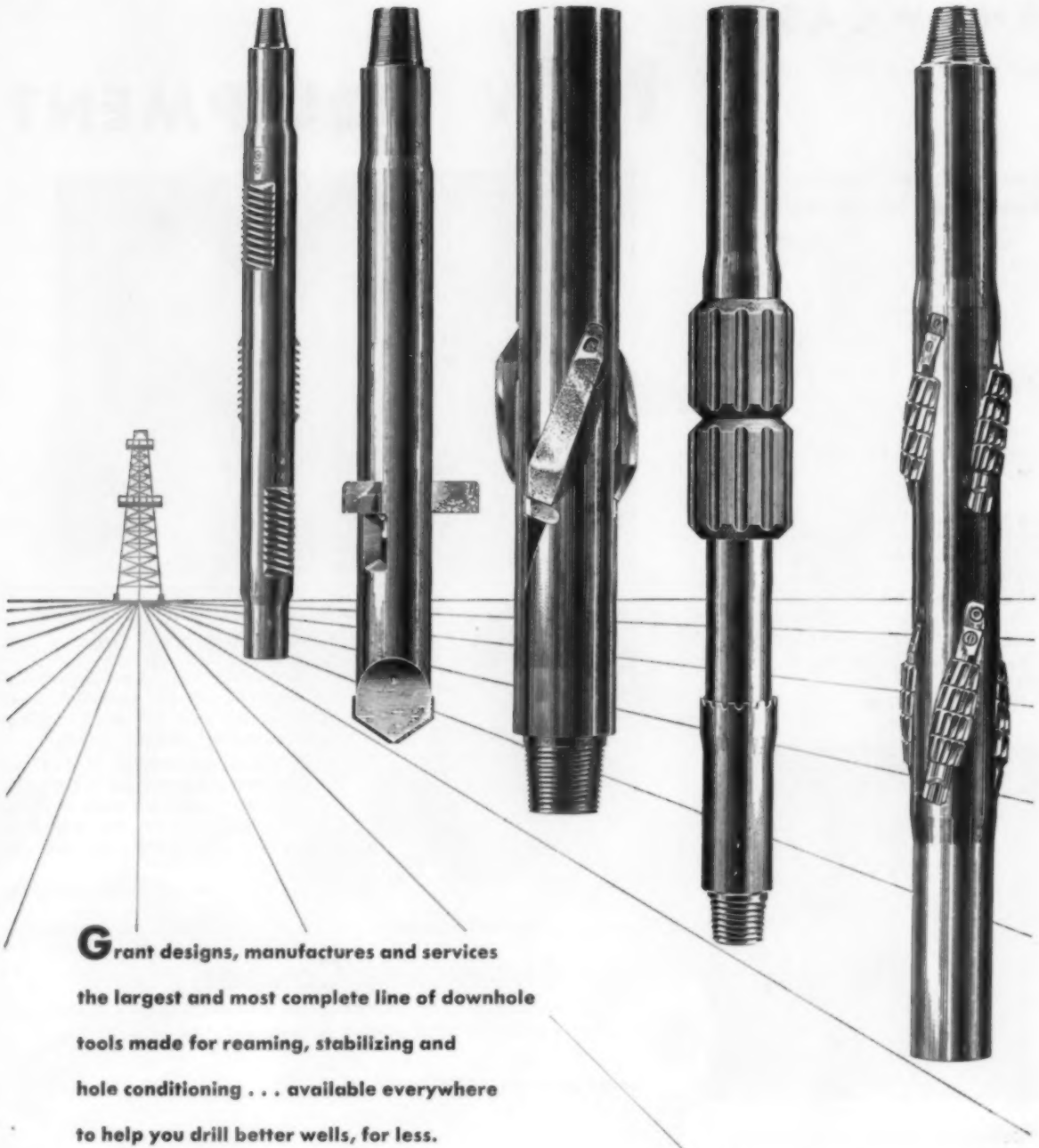

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- **EXPORT:** 17 Battery Place, New York 4, N. Y.

New Equipment

engine employs a high-pressure solid-injection fuel system filter. Standard equipment includes an air cleaner, engine-mounted muffler, and fuel-transfer pump. **Write or call: American Marc, Inc., 1601 West Florence Avenue, Inglewood, Calif., for details on AC-1 diesel.**

•

Solenoid Valve for Liquids Operates at 600 Psi.

Four sizes (2, 2½, 3, and 4 in.) of this new cast-steel solenoid valve for liquids at pressures to 600 psi. are now available. It comes in both globe and angle pattern with either screwed or flanged pipe ends.

Its features include renewable seat rings, unbreakable piston rings, and packless operation over a wide pressure range. The valve is designed to eliminate damaging hammer and shock in automatic or remote control systems.

The coils include greenclad waterproof molded coils for temperatures to 250° F. and silicone-insulated coils for higher temperatures. Coils are interchangeable between sizes and with all other Gould valves. **Write or call: J. D. Gould Co., 4707 Massachusetts Avenue, Indianapolis 18, Ind., for details on Type EO-2 solenoid valve.**

•

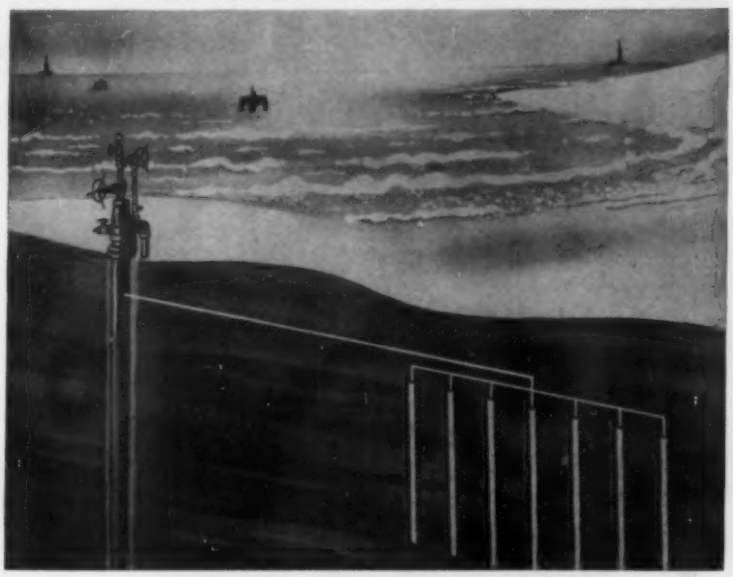
Truck Crane Unit Takes Up Little Space

Because it requires only 18 in. of space behind the truck or tractor cab, this truck-crane unit leaves almost the entire truck body free for useful payloads. Power for the truck crane, supplied by a power-takeoff-driven pump, is hydraulic in all phases of operation. Swinging in a 280° arc, the boom projects or retracts hydraulically in a horizontal position or at any point up to an 85° elevation. Both horizontal and elevating booms are available, offering speed, versatility, and increased capacity to loading and unloading operations, according to the maker. Their capacity is 5,000 lb.

Control levers on both sides of the truck permit operation from ground level. One lever provides forward, reverse, locking, and speed control for each power movement. The valve bank, which locks automatically when levers are released, has a relief valve for prevention of overloading and subsequent damage to equipment.

The high pivot point of the boom on the mast permits high loading up against the crane superstructure. Boom topping capacity is equal to winch loadline capacity. Stability is provided by hydraulic outriggers. **Write or call: Anthony Co., 1750 Baker Street, Streator, Ill., for details on truck crane.**

(More new equipment items continued on next page).



CASING IN 62 OIL WELLS PROTECTED FROM CORROSION

Here's how an oil producing company on the Gulf Coast stopped external casing corrosion on 62 of its wells. Five of the wells were in a salt water bay.

Potential-drop profiles indicated that cathodic protection could be applied to the total depth of 5,500 feet. CSI determined the current requirements, using the log current-potential method.

Then CSI engineers designed and installed a protective system for each well based on a guaranteed current output. The range of current requirements was from 0.5 to 6.2 amperes. The necessary current was delivered from ground beds each containing from two to 16 magnesium anodes. Galvomags, Dow's new high potential anodes, were used in special lengths to provide 10-year installation life at the lowest possible cost. This cost ranged from $215 to $510 per well.

Call or write today for estimates or quotations on your cathodic protection needs—materials or services No obligation.

CSI

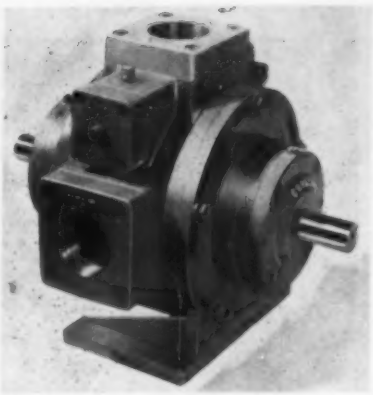
CORROSION SERVICES INCORPORATED
Tulsa, Oklahoma

P. O. Box 7343, Dept. J8 **Telephone: Circle 5-1351**

SHOWCASE . . .

New Equipment

L.P.G. Truck Pump Features Two Relief-Valve Systems



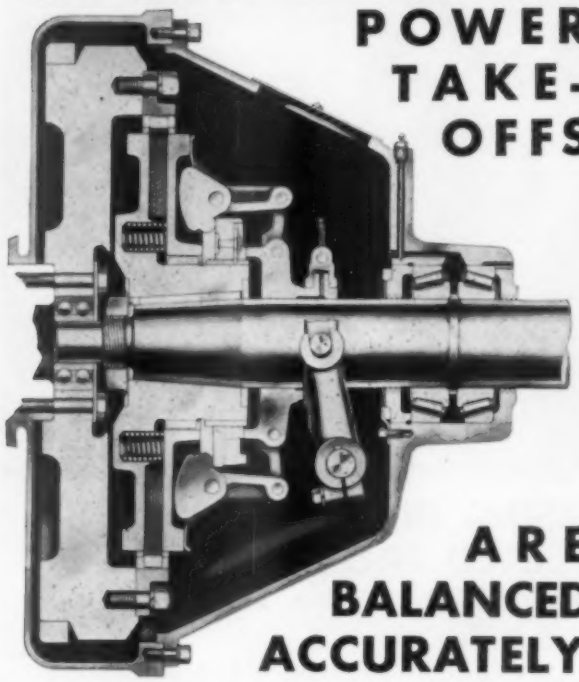
An unusual feature of this Coro-Vane L.P.G. truck pump is that it has two relief valves. One returns the liquid to the inlet when the pressure reaches 125 psi. The other can be piped back to the supply tank.

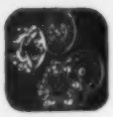
The pump is made of ductile iron, a metal which has the tensile strength of steel but is not brittle like cast iron. The pump has a capacity for a 1¼ or a 1½-in. meter.

It is equipped with flanged nozzles, which eliminates the need for unions in piping. The maker reports pump installation is no problem. The pump can be installed with any power-takeoff rotation. It can be mounted enginewise or counterenginewise, without dismantling because of twin shafts, one on each end of the pump. The mounting bracket permits turning the pump chamber and nozzles in a full circle. **Write or call: Corken's, P. O. Box 1062, Oklahoma City, Okla., for details on Coro-Vane pump.**

ROCKFORD

POWER TAKE-OFFS





Small Spring Loaded

Heavy Duty Spring Loaded

Oil or Dry Multiple Disc

Heavy Duty Over Center

Power Take-Offs

Speed Reducers

ARE BALANCED ACCURATELY

SELF CONTAINED UNIT
WIDE RANGE OF SIZES
CONSERVATIVE RATING
ROLLER BEARINGS
FINE ADJUSTMENT
ACCURATE BALANCE
S.A.E. DIMENSIONS

* The clutches used in ROCKFORD POWER TAKE-OFFS are carefully balanced to prevent centrifugal force from affecting efficient operation. A special machine checks the balance of each clutch within extremely close limits, before it passes final inspection.

Send for This Handy Bulletin

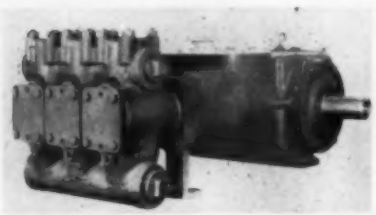
Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD Clutch Division BORG-WARNER

1305 Eighteenth Ave., Rockford, Ill., U.S.A.

Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

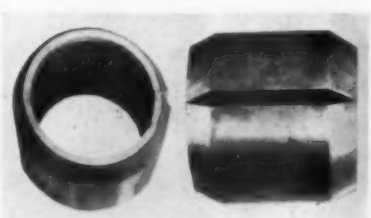
CLUTCHES



Triplex Plunger Pump Has Many Design Features

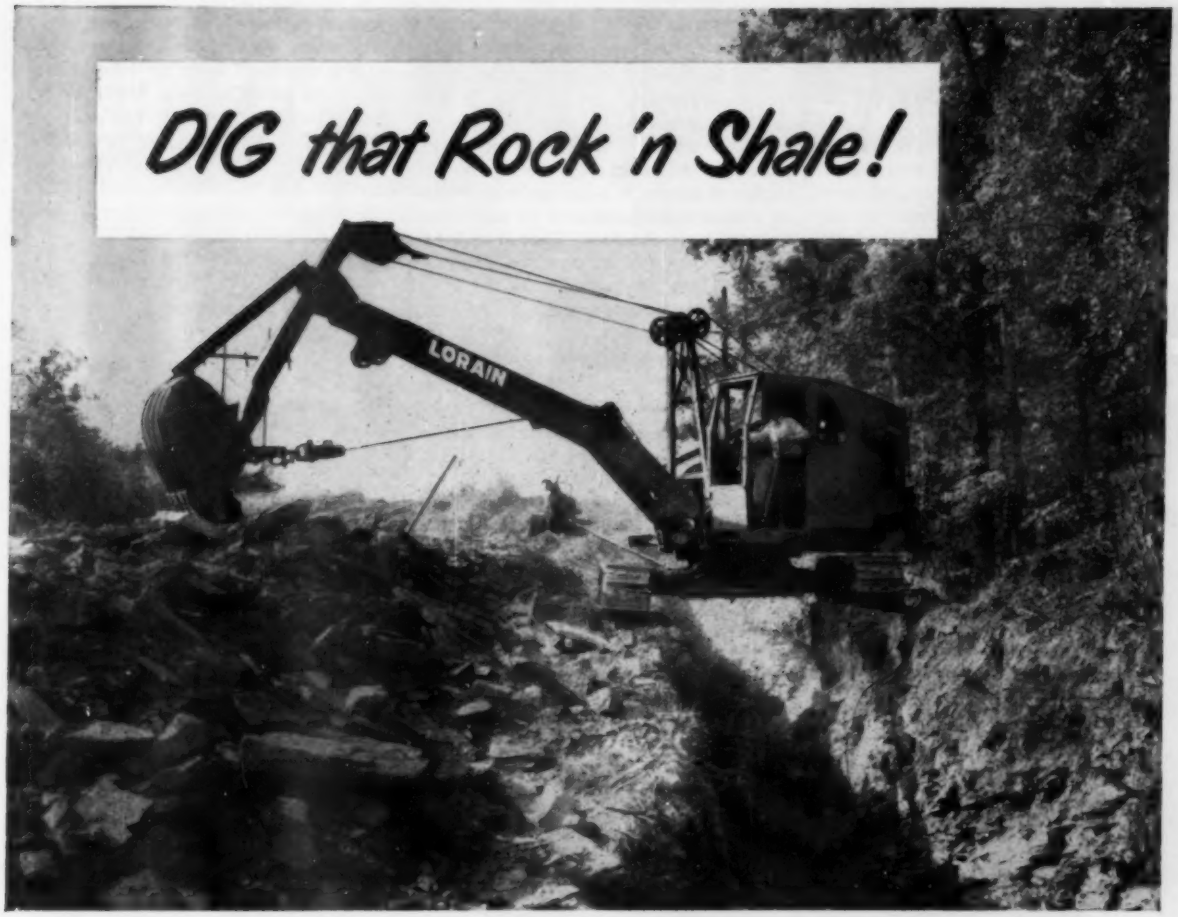
Called the P-300, this new triplex-power plunger pump incorporates interesting design features on both power and fluid ends. These include: (1) an offset crankshaft for long bearing life; (2) small discharge valves for reducing hammer; (3) large suction valves for position filling; (4) deep stuffing boxes for force-feed lubrication and long packing life; (5) five plunger sizes; and (6) cartridge type of cylinder-head stuffing boxes for easy access and maintenance.

The pump is capable of developing pressures up to 3,000 psi. and of turning at speeds up to 500 r.p.m. This extended range makes the P-300 applicable for installations often requiring a larger pump, the maker points out. **Write or call: Frank Wheatley Supply Co., 125 West First, Tulsa, Okla., for details on P-300 pump.**



Drill-Pipe Equalizer Reduces Tool-Joint Wear

Here is a new tool which reportedly aids in solving the problem of sticking



LORAIN "PIPELINERS" get the tough jobs!

Look at that trench! It's tough digging through rock and shale on a 17-mile stretch of 30-inch gas line in southern New York.

Tough jobs like this one go to Lorain "Pipeliners" because they put many outstanding features to work . . . for fast, powerful digging, ease of operation and real "stand-up" ability. Consider what these new design facts, available in the new Lorain-26 "Pipeliner," can mean to you: new operating ease and control with the finger tip, 2-lever, "Joy Stick-Hydra Ease" power controls; smooth digging power from a new torque converter that automatically matches digging needs; long crawler life with the big, husky crawler and heavier drive chains; long, wide crawlers for extra stability; fully-enclosed crawler propelling mechanism with sealed tread lock; flotation and ability to straddle wide trenches; smooth, free-swinging roller bearing hook rollers; sealed idler rollers for long, trouble-free life; plus a longer, heavier Hoe boom built to dig harder materials — deeper.

Be sure to get the *full* story on the Lorain-26 "Pipeliner" from your Lorain Distributor.

THE THEW SHOVEL CO., Lorain, Ohio

THEW LORAIN®

SHOWCASE . . .

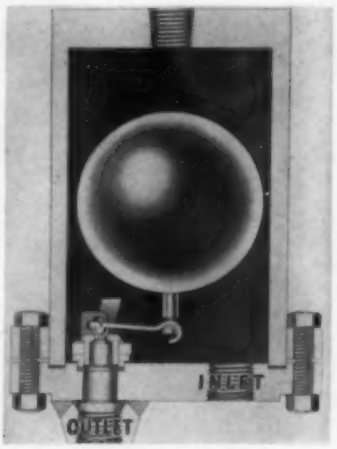
New Equipment

pipe opposite permeability because of differential pressure. Called a drill-pipe differential-pressure equalizer and protector, the tool can reduce wear on the drill pipe and tool joints and frictional drag, both in rotation and reciprocation of the drill pipe, the maker states. The equipment reduces the area of contact of the drill pipe with the well bore, permitting hydrostatic pressure to equalize around the drill pipe with the well bore for the length of the pipe, with the exception of the area of contact of the equalizer and tool joints.

The tool employs steel rather than rubber protectors. The two halves are welded together. The tool is designed to move with an 8,000-psi. pressure, although the frictional hold can be higher or lower. It is designed so it can be moved out of position in case of a twistoff near the tool. Thus it can be shoved down by an overshot. Moving the tool out of position on the drill pipe will not mar or damage the surface of the pipe.

Well-bore conditions requiring the use of the tool are those with considerable areas of permeability and differential pressure, directional holes, and wells where highly abrasive formations are encountered. **Write or call: Weatherford Oil Tool Co., Inc., 5920 Navigation Boulevard, Houston, Tex., for details on drill-pipe pressure equalizer.**

•



Dual-Gravity Trap Available in Two Series

This Clark dual-gravity trap for interface service is designed to discharge water or heavy liquids and to close for light liquids. The discharge valve is actuated by a stainless-steel ball float, weighted to sink in the light liquid and float in the heavy liquid.

The trap incorporates the Clark Duo-Step leverage principle, which uses two fulcrum points to develop maximum power and travel.

The trap comes in two series—semi-steel for low temperatures at pressures to 300 psi. and fabricated steel for low temperatures to pressures of 1,000 psi.

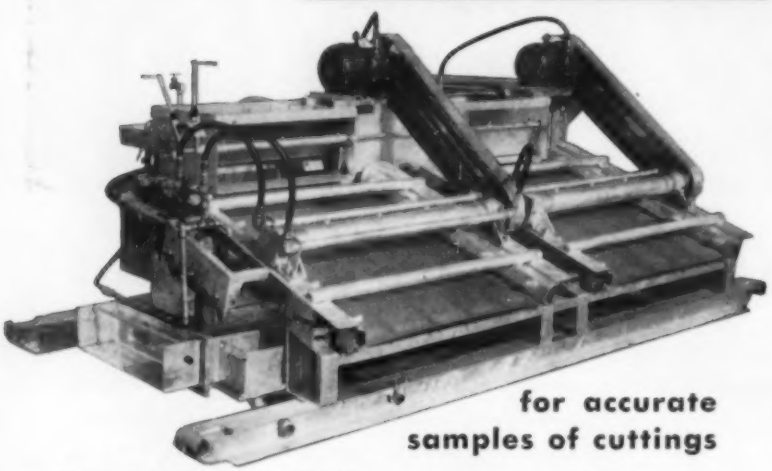
Its uses include removal of water from gasoline accumulators, settling tanks, evaporators, and pipelines carrying light liquids with water present. **Write or call: Clark Mfg. Co., 1830 East Thirty-eighth Street, Cleveland 14, Ohio, for details on dual-gravity trap.**

•

Sucker-Rod Wiper Serves as Blowout Preventer

This new Petol sucker-rod wiper not only quickly wipes rods dry but also acts as a blowout preventer. One size of the wiper handles all sizes of rods

Thompson
DOUBLE VIBRATING
SHALE SHAKER...and
SAMPLE MACHINE



for accurate samples of cuttings

The THOMPSON SHALE SHAKER SAMPLE MACHINE offers the operator and geologist one of the best methods available for obtaining accurate foot-by-foot samples of well cuttings.

This THOMPSON DOUBLE VIBRATING SHALE SHAKER and SAMPLE MACHINE is specially engineered for off-shore barges or islands, deep wells, or wells using big volume and high pressure mud pumps. It is available either plain or galvanized, which makes it rust and deterioration-proof on off-shore or coastal duty.

THOMPSON Shakers are famous for their highly efficient service at any depth or flow and for their economical first cost.

Make sure THOMPSON'S on the job for accurate samples and clean mud.

SOLD ONLY THROUGH SUPPLY STORES

Thompson TOOL CO.
IOWA PARK TEXAS

NOW — Automatic Drainage of High-Pressure Air or Gas Systems — Up to 3500 Psi

- **Eliminates Manual Bleeding**
- **Prevents Loss of Gas**
- **Saves Time, Trouble and Money**

The new Armstrong high-pressure gas trap illustrated *automatically* drains the system without gas loss. This completely reliable trap incorporates the time-tested Armstrong steam trap mechanism, adapted to the service.

Construction is of highest quality—forged steel body and cap, stainless steel working parts, heat-treated chrome steel valve and seat. Open-float bucket cannot collapse.

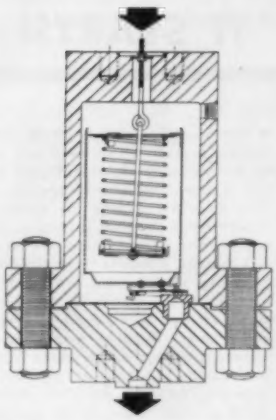
ASK FOR BULLETIN NO. 401 for complete details . . . lists physical data, prices and ordering information. Get your copy today — call your local Armstrong Factory Representative or write:

ARMSTRONG MACHINE WORKS
8687 Maple Street
Three Rivers, Mich

Satisfaction Guaranteed

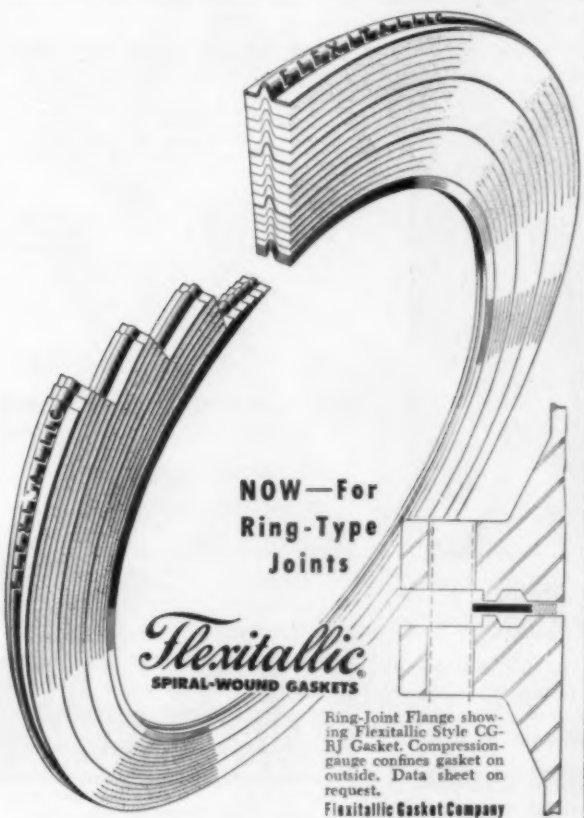
How It Works

Bucket is first primed with water, the weight of which compresses spring and closes valve. As condensate enters at top, it spills over side of bucket and begins to fill body of trap. When level gets about half-way up bucket, buoyancy of bucket plus spring action overcomes pressure and lifts bucket, opening valve. As condensate discharges, bucket loses buoyancy and sinks, closing valve. Valve *always* closes before all condensate is discharged, thus assuring a perfect water seal at all times.



4 SIZES

Trap No.	2315-S	2415-S	2515-S	2615-S
Max. Pressure	1000 lb	2000 lb	3000 lb	3500 lb
Capacity at Max. Pressure	7000 lb/hr	4200 lb/hr	5000 lb/hr	300 lb/hr
Pipe Connections	1", 1¼", 1½"	1", 1¼", 1½"	1"—1¼"	1"—1¼"



NOW—For Ring-Type Joints

Flexitallic
SPIRAL-WOUND GASKETS

Ring-Joint Flange showing Flexitallic Style CG-RJ Gasket. Compression-gauge confines gasket on outside. Data sheet on request.

Flexitallic Gasket Company
Camden, N. J.

resort luxury in downtown Miami

the new Fabulous Fourteenth floor—sumptuous one-of-a-kind rooms and suites for VIP's and truly discriminating guests!

the famed Top O' the Columbus—gourmet food; cocktails; supper dancing; panoramic views of ocean, bay, and city!

the convenient headquarters for your stay—downtown airlines terminal; near smart shops, theatres, and office buildings!

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STOP H_2S CORROSION BEFORE IT STARTS!

• The Connelly IRON SPONGE purification process at the well site removes hydrogen sulphide BEFORE the gas is piped to central processing. Thus, the cause of pipe line corrosion is eliminated because corrosive gas never enters the transmission lines. Additionally, Connelly IRON SPONGE eliminates the need for extreme close control. It operates with high efficiency at low or high pressures—absorbs more H_2S, gives longer service between foulings and is easily regenerated. If you have a purification problem check this MOST ECONOMICAL solution today. Write for Field Processing Bulletin #OG-7.

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1521 PRINCE ST., HOUSTON 8, TEX.
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New Equipment

from 5/8 to 1 in. without changes. And the rubbers in the wiper can be changed in a few minutes.

According to the maker, the wiper is quickly installed, easily operated, and requires little maintenance. If the rods are out of the hole, the wiper can be closed on the pony rod, hammer handle, or sucker-rod wrench handle to provide a seal. If the well heads while closed in, the gas and oil can be bled through one of the drain holes of the tool, threaded for a nipple and valve.

Instantly adjustable during the pulling operation, the wiper will function as a blowout preventer for wells that do not develop pressure in excess of 500 psi. Wells that develop pressure can be pulled without interruption to dissipate the pressure or without special provisions beforehand. This feature and its safety advantages are highly valuable on offshore wells where waste oil on the water would present a serious fire hazard, the maker points out.

The wiper has been tested by major companies and well-servicing contractors and has been proved in the field. **Write or call: Gearench Mfg. Co., P. O. Box 1221, Houston, Tex., for details on Petol rod wiper.**

•

Pressure Resin Splice Developed for Cable

Here's a new versatile method of protecting and insulating electrical splices with epoxy resin. The resin is injected into a mold tailor-made in the field.

Called the Scotchcast resin pressure splice, the new method is expected to find wide use for both buried and aerial cable. Due to the versatility of the method, lead, rubber, and plastic-sheathed cable, or even combinations of these, as well as shielded cable can be spliced. The method has worked satisfactorily on oil-saturated cable, the company reports.

The pressure-splice method uses an open mesh screen-like tape as a spacer material, wrapped around the splice. The plastic tape, in turn, is covered with a low-stretch tape to restrict the expansion of the plastic envelope when resin is forced into the splice. **Write or call: Minnesota Mining & Mfg. Co., 900 Fauquier Street, St. Paul 6, Minn., for details on Unipak pressure splice for cable.**

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OIL INDUSTRY FILING EQUIPMENT

HORIZONTAL ROLLFILE H-342-354

Built to stack in tiers to save space. Sturdy, all-steel construction . . . several sections fully loaded can stack on same leg base. Disappearing section doors completely clear for complete accessability. Index plates on ledges provide perfect file control of maps. All doors fitted with locks.

Model V-96 Vertical Rollfile

Model E-28 Electric Log Cabinet

KRAFTBILT All-Plastic Map sticks and other KRAFTBILT accessories are designed for maximum utility and service.

WRITE for Catalog 57-B on Kraftbilt

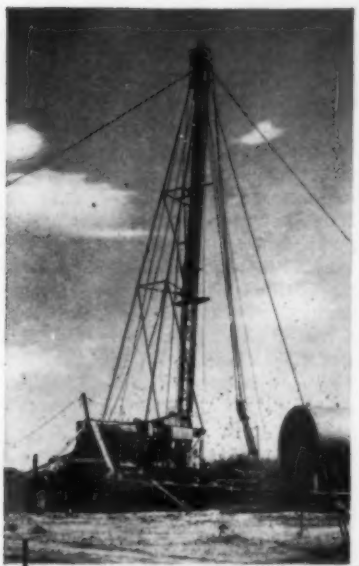
ROSS-MARTIN COMPANY
P. O. BOX 800 TULSA 1, OKLA.

HYDROCARBON WELL LOGGING

Domestic and Foreign

CARAN ENGINEERING CORPORATION
MILAM BLDG. SAN ANTONIO
Branch Offices: Houston and Alice, Texas and Lafayette, Louisiana

NOW—your choice of THREE derricks for use with the Bucyrus-Erie 48-L



For deep hole drilling and servicing performance at its versatile, moneymaking best, you NOW have a choice of *three* derricks for use with the field-proved Bucyrus-Erie 48-L spudder. Each is specifically designed to handle your different kinds of work:

1. The *Standard 61' Derrick* for normal top-to-bottom drilling to 6,000 feet and well servicing to 7,000 feet;
2. The *Special Heavy Duty 70'4" Tripod Derrick* for heavy tool and casing work (handles up to 300,000-lb. casing loads with 10-part hoist);
3. The *Special 85' Servicing Derrick* for deep well workovers (handles up to 60,000 pounds of tubing, easily racks 30-ft. doubles).

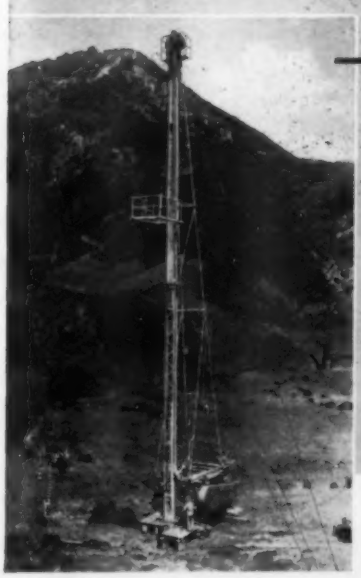
Look over the illustrations and specifications. Select the derrick best suited to your needs. Then, use the coupon to get the full story.

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

Standard — field-proved and unexcelled for strength and durability; telescopes to 39'3"; power-raised and power-lowered for quick, easy setups; swings up to 6,700-lb. tool strings; handles tackle pulls up to 160,000 pounds with auxiliary A-frame.

Tripod — the choice where a heavier derrick of greater height is required; power-raised and power-lowered; five-unit assembly is easily erected, quickly torn down for moves . . . each unit transported separately for convenience.



Servicing — a compact traveling unit with the necessary extra height, big capacity and strong structural design; telescopes and is power-lowered to lay down over the spudder for fast road travel; power-raised for easy field erection. Fingerboard arrangement holds up to 7,920 feet of tubing in 60-ft. stands.

FIRST with the FINEST in Spudders

BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

Please send me further information on the following derricks for use with the 48-L:

☐ Standard ☐ Tripod ☐ Servicing

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ADDRESS.....

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43557

Why the "Roustabout 1523" is the best all-purpose jack for drillers

First, the "Roustabout" (Jack No. 1523) has plenty of power—15-ton capacity for loads applied to either head or foot lift. Second, this well-balanced jack can work at any angle at full capacity (note swivel base). Third, its slotted head takes special claw or chain for lifting, lowering, pushing or pulling pipe, beams, poles, etc. Fourth, the "Roustabout" oil field jack is equipped with a patented adjustable spring mechanism which assures positive engagement of rack teeth. The spring's tension can be easily adjusted with a screw driver without removing any part of the jack. Send for Oil Field Jack Bulletin Ad-19B.

You can get the "Roustabout 1523" at your favorite supply store!

DUFF-NORTON

Duff-Norton Jacks

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P. O. Box 1889 • Pittsburgh 30, Pennsylvania

COFFING HOIST DIVISION: Danville, Illinois

Rachet Jacks, Screw Jacks, Hydraulic Jacks, Special Worm Gear Jacks, Rachet Hoists, Electric Hoists, Load Binders, Spur Gear Hoists

SHOWCASE . . .

New Literature

Slush Pump Maintenance Manual, a new 60-page publication including about 150 pictures, diagrams, and charts, is devoted principally to the consideration of fluid-end pump parts. It also takes up the pressure side of the hydraulic system, surface mud system, suction conditions, and selection of drilling fluids. The manual discusses the importance of piston-liner clearance, location of troubles that cause knocking, and typical fluid-end pump parts troubles and possible causes. It also furnishes a table of pump capacities and gives measurements for ordering rods and liners. **Write or call: Mission Mfg. Co., P. O. Box 4209, Houston 14, Tex., for "Slush Pump Maintenance Manual."**

•

Two-Channel Galvanometer Recorder for recording such variables as voltage and current, temperature and pressure, torque and speed, and input and output is the subject of six-page Bulletin R-502. The two-color bulletin gives detailed interior and exterior design features of the instrument. It also presents the instrument's accessories and specifications. The dual recti/riter records two functions rectilinearly on two full 4½-in. scales on a single chart. It is available with a 10-speed fingertip-controlled transmission. **Write or call: Texas Instruments, Inc., Industrial Instrumentation Div., P. O. Box 6027, Houston 6, Tex., for Bulletin R-502.**

•

Rod Wiper. This new four-page folder covers a new type of sucker-rod wiper. It gives complete drawing details of the new tool with both cutaway and photographic detail. The folder also includes features, specifications, and parts lists for the rod wiper. **Write or call: Gearench Mfg. Co., P. O. Box 1221, Houston 1, Tex., for folder on sucker-rod wiper.**

•

Inflatable Hut measuring 30 by 19 by 9 ft. and weighing only 160 lb. is the subject of this new pocket-sized four-page leaflet. Besides describing its structural features, the leaflet lists several uses for the inflatable, portable shelter. These include use as a temporary building at construction sites and as temporary housing for field crews. According to the leaflet, the hut can be erected on any ground in about 3 minutes with a small electric blower, driven from a truck battery. The portable hut is said to be perfectly stable

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70
Locations in the United States and Canada

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Service
Anywhere Anytime

New Services • • • New Tools • • • New Methods • • • Outstanding Results

Radiation Logger Gives Accurate Detail in 98% Saturated Brine Fluid

This was a multiple well logging project in brine wells in a Michigan field. All operations were performed above 2000'. Wells were cased with 3" O.D. pipe inside of 6" O.D. casing. Fluid was 98% saturated brine solution.

The 14 wells in this particular project were logged with 1¾" O.D. McCullough Radiation Well Logging instruments, averaging 1½ hours working time per well.

Because of the heavily saturated brine solution, other types of logging instruments had not been able to provide required information. All McCullough logs were sharp, clear and detailed. Location of casing collars and bottom of pipe, information that had not been obtainable before, was clearly indicated.

McCullough

Radiation Well Logger

Have you received your copy of this new bulletin? Write to McCullough Tool Company, 5820 South Alameda Street, Los Angeles 58, California. We will send your copy by return mail.

The jobs described above are certified to be true field reports of services rendered.

Scintillation Counter Picks Thin Zones for 960 B/D

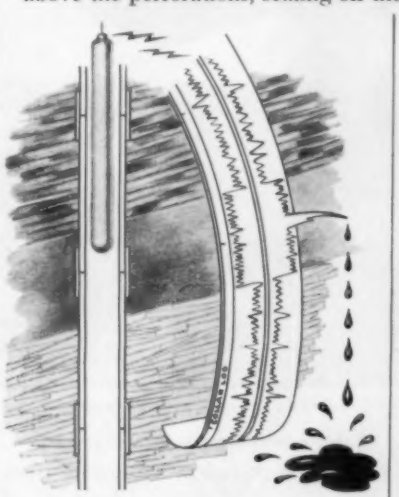
Accurate Down-Hole Information, Provided by McCullough Gamma Ray & Neutron Logs, Assured Pin-Point Perforating of Three 4' Zones For a Fine Producer.

Total depth of this Kansas oilwell was 3648'. 5½" O.D. 14 lb. casing had been set to bottom and cemented.

McCullough's Radiation Well Logger obtained Gamma Ray and Neutron Curves and a simultaneous collar log. Logging information was correlated with the operator's drilling log and three four-foot zones were picked as possibly productive.

The three zones were perforated, one at a time, by 3¾" O.D. McCullough Standard Casing Glass Jets in Steel Strip Carriers. A total of 52 shots were fired.

The lower zone proved to be water bearing and a bridge plug was set above the perforations, sealing off the zone. Upper zones were productive and made approximately seven barrels of oil per hour.



Exact measurement and definition of any potentially productive interval, thick or thin, assures "putting the shots where they count" for greater production—more oil!

Well was then acidized and on test made 40 barrels per hour, or 960 barrels of oil per day. This was the best well in the field.

McCullough's Radiation Well Logger is the most reliable logging instrument available. It has greater stability, provides more detail and assures more accurate quantitative interpretation. The efficiency of the McCullough Scintillation Counter makes it possible to log thin zones with clarity and accuracy.

The simultaneous recording of a collar log means placing the perforations exactly where they are wanted—fully covering the productive formation. And, as in the above case, this means "best possible production"—the best well in the field.

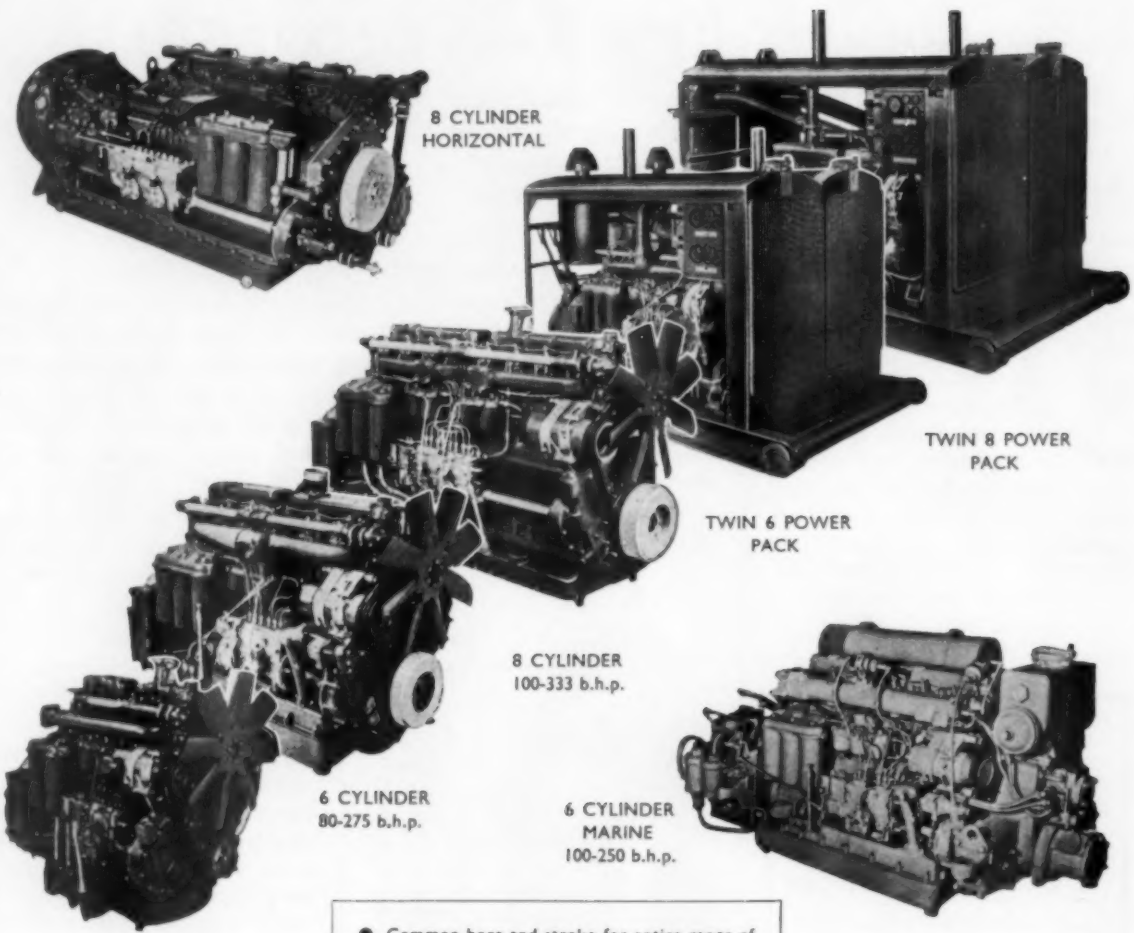
McCullough® TOOL COMPANY

Cable Address: MACTCOL

LOS ANGELES
HOUSTON
EDMONTON

ROLLS-ROYCE

OIL ENGINES



- Common bore and stroke for entire range of four, six and eight cylinder engines
- Spare parts common to all engines
- Right or left hand build, horizontal or vertical

A range of unsupercharged and supercharged 60-600 B.H.P.

IN SERVICE IN WORLD OIL FIELDS

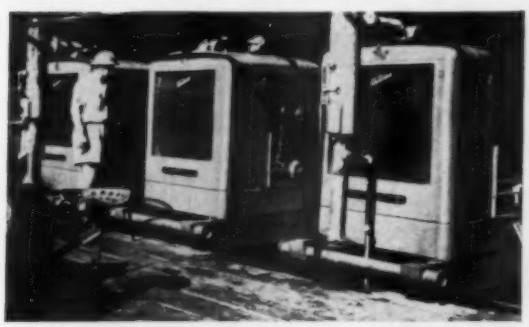
for Automotive, Industrial, Marine and Railway applications

High Speed Personnel Launches — Maracaibo

Woodfield Hoist Drilling Rig — Trinidad

Scammell Constructor — Muscat, Oman

Woodfield Hoist Servicing Rig — Seria, Borneo



Petbow Generating Set — Seria, Borneo

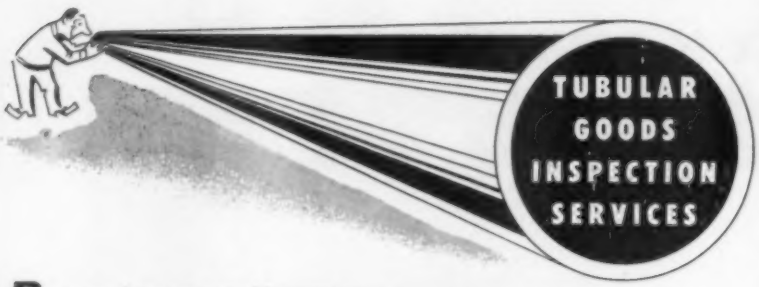
C.P.T. Air Compressor — Iraq

ROLLS-ROYCE

OIL ENGINES

ROLLS-ROYCE LIMITED, OIL ENGINE DIVISION, DERBY, ENGLAND

Take a closer look at . . .



PLASTIC APPLICATORS' inspection procedure—preceded by descaling, degreasing and sand blasting to bare metal—repeatedly turns up hidden defects exceeding API specifications in field-inspected tubular goods. For example, here's what re-inspection after cleaning revealed in three recent jobs:

1.	LOT: 372 joints	
	FOUND DEFECTIVE PRIOR TO CLEANING	13
	FOUND DEFECTIVE AFTER CLEANING	32
2.	LOT: 330 joints	
	FOUND DEFECTIVE PRIOR TO CLEANING	14
	FOUND DEFECTIVE AFTER CLEANING	23
3.	LOT: 156 joints	
	FOUND DEFECTIVE PRIOR TO CLEANING	0
	FOUND DEFECTIVE AFTER CLEANING	20

These defects were confirmed by field inspection companies themselves. They positively demonstrate the necessity for thorough cleaning to bare metal before inspection and coating. Plastic Applicators offer you a choice of optical and magnetic inspection and hydrostatic testing. All joints are tested with API drift for diameter and straightness; upset areas on grades above N-80 are blasted to white metal. Work inspected by us is handled only one time and may be stored in our yard until required. You save time and get a *closer* look at no additional expense when you use this superior service.

WRITE FOR FULL PARTICULARS AND PRICES

Plastic Applicators, Inc.

TUBULAR GOODS INSPECTION SERVICES
BAKED-ON PLASTIC COATINGS

HOME OFFICE AND PLANT:
P. O. Box 7631, Houston, Texas. Phone: UN 9-2491.
BRANCH OFFICES AND PLANTS: P. O. Box 388, Harvey, La. Phone: Fillmore 1-1636—P. O. Box 2749, Odessa, Texas. Phone Emerson 6-4491.
SALES OFFICES—TEXAS: Houston, Corpus Christi, Dallas, Midland, Odessa. LOUISIANA: Lafayette, New Orleans, Harvey.

7164

in high winds and completely waterproof, even in tropical storms. **Write or call: Elliott Equipment, Ltd., 20 A High Street, Canterbury, Kent, England, for details on Numax hut.**

•

Plastic Pipe and Fittings for pressures to 110 psi. and temperatures to 120° F. in sizes from 1¼ to 2 in. are pictured and described in this new eight-page brochure. Tables give sizes, dimensions, weights, pressure drop for water, pressure-temperature ratings, and recommended pumping depths (in feet) for the pipe. The brochure contains a cutaway diagram and step-by-step instructions for installing plastic fittings and insert adapters. **Write or call: Crane Co., 836 Michigan Avenue, Chicago 5, Ill., for copy of plastic pipe and fittings brochure.**

•

Protective Tape Coatings for the protection of underground pipelines and for aboveground installation where corrosive agents are a threat to machinery, piping, and fixtures are the subject of this new 25-page, 2-color catalog. Starting off with the nature of corrosion and its control, the text leads into the advantages of wrapping with Polyken polyethlylene tape. An additional section concerns specifications, surface preparations, taping and wrapping, inspecting, repair, and special wraps for welded pipe. Pipe-coverage data are also given for all widths of tape. **Write or call: Kendall Co., Polyken Sales Div., 309 W. Jackson Blvd., Chicago 6, Ill., for protective tape coatings catalog.**

•

Oil Storage Tanks. This four-page bulletin describes the standard sizes of a line of welded-steel oil-storage tanks. The bulletin discusses types of roofs, welding, testing, and maintenance. And it lists accessories furnished with each standard flat-bottom tank. Two tables give dimensions of the standard sizes, available in capacities from 500 to 268,000 bbl., designed in accordance with A.P.I. Specification No. 12-C, Thirteenth Edition, and Supplement 1, October, 1956, for all-welded oil-storage tanks. **Write or call: Chicago Bridge & Iron Co., 332 South Michigan Avenue, Chicago 4, Ill., for bulletin on oil-storage tanks.**

•

Basic Check Units which can be combined with any standard pipe fitting to form a complete check valve are described in this new eight-page bulletin. Illustrations show the unit

STANDARD
RED CROWN
STANDARD
What makes a company a good citizen*
If Michigan is your home state, chances are you have already seen this advertisement. Or, if you live in one of the other Midwest and Rocky Mountain states where Standard Oil Company (Indiana) products are sold, you may have seen an advertisement very much like it with the same straightforward information about what determines gasoline prices in your state. This is the type of factual, informative advertising so vital to a sound public understanding of the oil business and its products and services.

Four important things that affect the price you pay for gasoline in Michigan

TAXES—You might be surprised what a big chunk of your gasoline dollar goes for *direct taxes* placed on gasoline by federal and state governments. These taxes are largely used to build and maintain our expanding highway system and are collected from you at the gasoline pump. In Michigan the direct taxes on regular grade STANDARD RED CROWN Gasoline total 9 8/10 cents per gallon—*equal to 42 percent of the price of the gasoline alone in mid-Michigan areas.*

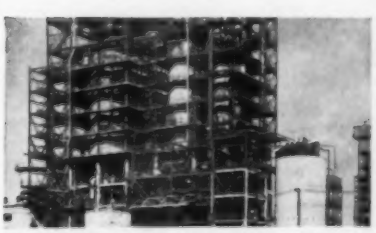
PRODUCT IMPROVEMENT—Today's gasoline looks and smells about the same as gasoline has for years *but your car can tell the difference.* The STANDARD RED CROWN you use today is higher quality, higher octane than our Premium Gasoline was only 4 years ago. Such dramatic product improvements are costly. During the past two years octane increases alone added about 25 million dollars per year to our continuing operating costs.

WAGES—The money you pay for RED CROWN helps, too, to pay the wages and salaries of the 52,000 men and women in our immediate "family". They are people like yourself who have had to meet rising living costs. General wage increases of slightly over 4 percent and 6 percent in 1955 and 1956 increased our costs about 28 million dollars annually.

SERVICE—Your Standard Dealer is an independent business man in a keenly competitive business. A few cents per gallon mark-up is all that competition allows him if he is to attract and hold your business. This modest mark-up enables him to offer and maintain essential services for car owners. At the same time, it must help cover his many costs and earn him a fair profit.

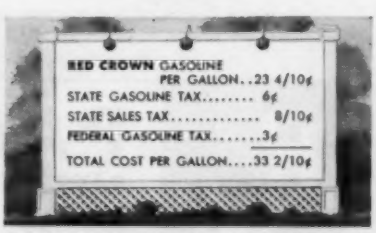
*** WHAT MAKES A COMPANY A GOOD CITIZEN?**

Because gasoline is widely used and needed, its price is a matter of interest to a great many people. The communities in which we live and serve are entitled to information this company can give them on factors affecting gasoline prices.



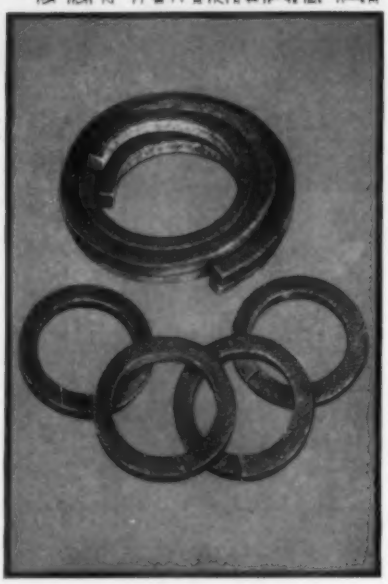
Modern gasoline quality represents tremendous investments in better facilities and processes, and in research. Yet in America today an hour's pay buys more than half again as much gasoline, excluding direct taxes, as it would fifteen years ago.

In the last 15 years Standard Oil salaries, wages and benefits on the average have increased about 170%. This is important to each Standard Oiler and important to the welfare of the communities where our "family" members live and work.


RED CROWN GASOLINE PER GALLON..23 4/10¢
STATE GASOLINE TAX..... 6¢
STATE SALES TAX..... 8/10¢
FEDERAL GASOLINE TAX.....3¢
TOTAL COST PER GALLON....33 2/10¢

The taxes you pay on gasoline—equal to 42% of the price of the gasoline itself in mid-Michigan—help to build and maintain Michigan's expanding highway system. You pay these direct taxes whenever you buy gasoline.

STANDARD OIL COMPANY (INDIANA) STANDARD



R/M UNIVERSAL PLASTIC PACKING...

No. 1 choice of the petroleum industry

R/M Universal Plastic Packing has won a reputation in refineries for keeping maintenance low and performance high. Composed of long-fiber asbestos, a special binder and nonfrictional metal, this packing does a top-flight job of sealing on centrifugal pump shafts, valve stems, reciprocating rods, and other equipment. It is recommended for use against gasoline, fuel oil, and other petroleum products.

This packing is available in standard sizes: 1/8 x 5/32 in. rectangular cross section; 3/16 to 1/2 in. round cross section; 1/2 to 1 in. square cross section; all in increments of 1/16 in. It can be had in both spiral and ring forms, butt or bevel cut.

R/M's engineering staff, with its wealth of experience in packing problems of all kinds, will be glad to assist you at any time. Write today for catalog on R/M Mechanical Packings and Gasket Materials.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS—including Vee-Flex, Vee-Square, Universal Plastic, and "versi-pak"®; GASKET MATERIALS, "TEFLON"* PRODUCTS. SEE YOUR R/M DISTRIBUTOR.
* A Du Pont trademark

R/M

PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; Neenah, Wis.; No. Charleston, S.C.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

used with a reducing bushing, 45° ell, side outlet, drain elbow, bend, and standard elbow, as well as with tanks and pressure vessels. The bulletin furnishes sizes and weights for the basic check units, vacuum breakers, and reducing couplings. The latter are used where a complete stainless-steel check valve is required. Packaging information is also included. **Write or call: Durabla Mfg. Co., Inc., 114 Liberty Street, New York 6, N. Y., for basic check valves bulletin.**

•

Indicating Pneumatic Transmitter for measurement and transmission of flow, liquid level, and differential pressure is explained and illustrated in new four-page Bulletin 214-1. A cross-sectional diagram illustrates the transmitter and other diagrams give dimensions and details for pipe and wall mounting of the unit. **Write or call: Barton Instrument Corp., 580 Monterey Pass Road., Monterey, Calif., for Bulletin 214-1.**

•

How Piping is Fabricated, a 16-page brochure, explains the fabricating operation of Flori Pipe Co. The brochure photographically illustrates the firm's equipment, materials and processes, including pipe-bending facilities, welders, X-ray machines, heat-treating furnaces, pipe and fittings inventories and other facilities for piping fabrication. **Write or call: Flori Pipe Co., 601 East Red Bud, St. Louis 15, Mo., for brochure, "How Piping Is Fabricated."**

•

Slush-Pump Pistons Catalog (eight pages) furnishes complete specifications and construction features of a line of fluid-end pistons. A convenient table on the back cover gives the approximate horsepower required for power slush-pump operation for pump sizes from 6 by 12 to 7¾ by 20. The table covers working pressures from 200 to 1,000 psi. and speeds from 40 to 60 r.p.m. **Write or call: Hicks Rubber Co., P. O. Box 1302, Fort Worth, Tex., for slush-pump piston catalog.**

•

Industrial Gas Chromatograph designed for continuous, automatic analysis of process streams, using an unusual sampling valve and timing system is the subject of new four-page Bulletin 802. A diagram explains the operating principle of the chromatograph, and a table gives its specifications. **Write or call: Process Instruments Div., Beckman Instruments, Inc., Fullerton, Calif., for Bulletin 802.**

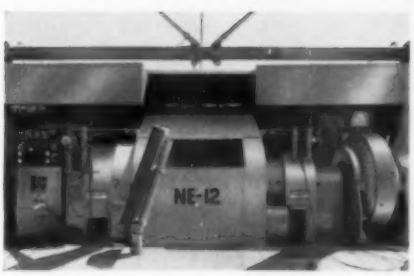
NE-12

OVER 45 YEARS EXPERIENCE

Mr. Arthur

(Coral Drilling Company)

ANOTHER BREWSTER EQUIPPED SEAGOING GIANT



BREWSTER NE-12 — 20,000-ft. diesel-electric drawworks expressly designed for offshore drilling.

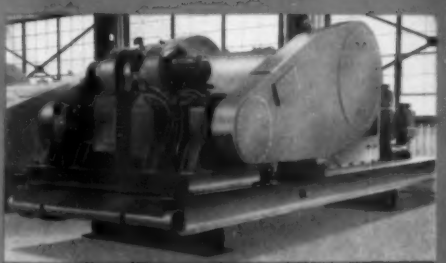
Brewster is among the first to recognize the need to build a drilling rig that meets the highly specialized requirements of platform operation. Designed for the job offshore, the big Brewster NE-12 drawworks on Mr. Arthur's deck is a true seagoing drilling rig. Diesel-electric powered, the drawworks has two 625 h.p. motors mounted on the short main skid. At the drum, the driller has four hoisting ratios to supplement the infinite speed range possible with electric motors. Capable of 20,000-foot drilling, the Brewster drawworks has the reserve power to go on down on even deeper wells. Every component, from the short easy-to-skid drawworks package to the simplified control panel,has been carefully planned to provide maximum power, control and flexibility . . . all in the smallest possible deck space.

While your new offshore venture is still in the planning stage . . . call in Brewster for experienced designs in diesel-electric offshore drawworks.

BREWSTER

BREWSTER OFFSHORE DRAWWORKS

NE-12



EFFORTLESS CONTROL of every operation by the driller is made possible through a simplified control panel. His full attention is centered on the job to be done which promotes faster drilling and greater crew safety. Mounted on the main skid, the control panel moves as an integral part of the drawworks package.

1250 HORSEPOWER at the drawworks is provided by dual input drives from two 625 horsepower electric motors. The two-speed transmission, coupled with high and low drives at the drum, gives four hoisting ratios to supplement the infinite speed range possible with the electric motors. Short in length, the drawworks package requires a minimum of deck room . . . can be skidded around to permit 6 or 12-well drilling.

FLEXIBILITY of equipment arrangement is of major importance on space-limited offshore platforms. Mr. Arthur is equipped with these two D-1000 series mud pumps which were unitized with 650 h.p. motors. They can be skidded in the most favorable position for manifolding to the mud lines. Only an electric cable need be laid to obtain full driving power.

COMPLETELY PACKAGED the diesel-electric sets occupy a minimum of space . . . can be placed anywhere on the platform without regard to drawworks or pump locations. Individually skidded, they need only connection to fuel lines to go to work.

MR. ARTHUR'S "KING SIZED" MEASUREMENTS

Length over-all	*180'0"*	*Bottom to helicopter deck*	*102'0"*
Width over-all	*151'0"*	*Bottom to top of mast*	*240'0"*
Draft under tow	*7'6"*	*Drilling Complement*	*44 men*

SUPPLY HOUSES

Howard Supply Company • Apex Equipment Company • Bovaird Supply Company • Industrial Supply Company • Murray Brooks, Inc. • United Supply and Manufacturing Company • Export Sales: The Brewster Company • (HOMCO) Houston Oil Field Material Company, New York, N. Y., Houston, Texas; Mexico City, D. F.

THE BREWSTER COMPANY, INC.

Shreveport, Louisiana

EQUIPMENT MEN . . . in the News

Southwest Industries Begins New Shop and Office

Southwest Industries, Inc., has begun construction of manufacturing facilities in Houston which will include a 30,000-sq.-ft. shop building and office structure in the Lumpkin industrial district, according to Jay L. Cannon, Jr., president.

The main shop building will be 100 by 260 ft. and the office building will be a one-story unit of 3,000 sq. ft.

The organization has home offices in Houston and branch offices in Tulsa and New Orleans. Sales are world-wide with export shipments during recent months being expanded to include Peru and Canada.

J&L Names Chief Engineer, Production Equipment Sales

W. K. GARMS

William K. (Bill) Garms has been appointed chief engineer of Jones & Laughlin Supply Division's production equipment sales section at the firm's headquarters office in Tulsa.

According to W. L. Wolfe, vice president, sales, Garms will assist W. R. Clarke, manager of production sales, in promoting the sale of all production equipment. However, Garms will give attention to the development of J&L's pump unit and water-flood equipment sales.

Garms joined J&L Supply's machinery sales force in 1947. After 4 years in private business, he returned to J&L and has since specialized in the engineering of pumps and rotary equipment.

Homco Announces Fifteen Promotions and Transfers

Promotions and transfers announced by Houston Oil Field Material Co., Inc., include: I. G. Alley, Canada district manager, Edmonton, to fishing tool supervisor, Morgan City, La.; Nash Campise, technical consultant to technical consultant and plant manager; W. H. Dodson, Jr., salesman to store manager; Al Eschenfelder, Houma to Houston; James J. Gross, warehouseman, to assistant store manager; Roy T. Hill, fishing tool salesman, New Iberia, to store manager.

Rudolph A. LaBauve, fishing tool salesman, New Iberia, to store manager, Houma; Al G. LaCasse, rigger to fishing tool supervisor; John A. Lonon, night helper to electrical well service rigger; Kerry K. Nicklas, pickup driver to warehouseman; Rodney J. Ory, Harvey to Houma; C. W. Scamman, Mud Miser manager to city salesman; G. C. Schmidt, store manager, Houston, to city salesman; James M. Weatherford, assistant store manager to field salesman; and Otho Young, New Iberia to Morgan City.

J. H. Williams Holds National Sales Meeting

J. H. Williams & Co., Buffalo, N. Y., manufacturer of industrial wrenches, tools and drop-forgings, has just concluded a 4-day national sales conference. The conference was attended by: (first row) R. D. MacDonald, W. J. Johnson, R. H. Runnalls, J. J. McCann, J. B. Perkins, J. C. Malugen, E. R. Burkardt, G. W. Caruso, W. Henry, J. J. Slosson, J. R. Armstrong.

Second row: G. A. Hunicke, A. M. Mezey, H. G. French, J. I. Cheney, A. C. Pontius, W. C. Harck, H. N. Maurer, R. I. Barnstead, M. E. Bulav, E. G. Brown, A. E. Buck, M. H. Durston, F. B. Roberts, G. W. Sudbury, A. C. Connor.

Third Row: D. D. Esinhart, D. R. Hill, D. Bethke, C. A. Roberts, J. W. Murray, A. B. Long, W. Rishel, J. F. Fitch, L. J. Sauter, C. T. Voyles, R. W. Richards, A. W. Martin, W. M. Silliman.

National Supply Elects Swaim Sales Vice President

Election of M. E. Swaim as vice president-sales, a newly created position, has been announced by The National Supply Co. Swaim has been general manager of sales since January 1956. He joined the company at Tulsa in 1925 and served subsequently in various sales and field-engineering capacities at Wichita, Kans., and Clay City and Olney, Ill. He spent 2 years in the engineering department at the company's Toledo, Ohio, plant and in 1944 was appointed manager, plant products division, Houston.

He was appointed sales manager, production equipment, in 1948 and in 1954 became general manager of oil-field sales.

National Lead Names Coale as Vice President

George B. Coale has been elected a vice president of National Lead Co. He continues as general manager of the company's Baroid division. His headquarters will remain in Houston.

Coale joined National Lead in 1935 as chief engineer of the power plant at the Sayreville, N. J., titanium pigment operation, then as plant mechanical superintendent. In 1949 he was transferred to the Baroid division as assistant general manager and became general manager in 1954.

Polyken Tape Coating to Go on 88-Mile Pipeline

The Polyken sales division of The Kendall Co. will supply Polyken 900 protective tape coatings for use by Natural Gas Pipeline Co. of America on its 88-mile, 20-in. line between Bridgeport, Tex., and Lindsay, Okla. Installation will begin in early June.

This will be the second big inch pipeline on which the Polyken method has been used in recent months. Polyken was applied to the 122-mile, 22-in.

American Louisiana Pipe Line Co.'s line between Defiance, Ohio, and Bridgman, Mich., last fall.

Distributor Named for Grant and MacClatchie

Tom Eakin Oil Tool Service of Willows, Calif, has acquired the northern California distributorship for Grant Oil Tool Co. and MacClatchie Manufacturing Co. oil-field drilling and production equipment. Eakin, who heads the distributing firm, has spent the past 30 years in the oil business, 16 of those years being with major oil companies. He started his own supply company a year ago.

The Grant and MacClatchie lines include a complete line of stabilizing tools, reamers and fluid-end pump parts as well as a full line of production equipment.

Vandenberg Visits S. A. For Fluid Packed Pump

Don Vandenberg, sales manager for Fluid Packed Pump Co., manufacturer of Oilmaster pumps and specialties, recently left on a 3-weeks trip to Venezuela. He is returning via New York where he will visit leading oil companies' export offices.

Faulk Visits H. C. Smith's South American Agents

Ray Faulk, export manager, sales, for H. C. Smith Oil Tool Co., is on a 2 months business trip to South America. Faulk will meet with the company's representatives and tour the various oil fields in Venezuela, Colombia, Peru, Bolivia and Uruguay. On his return trip Faulk will visit Panama, Guatemala and Mexico.

Oilwell Appoints Baker, Transfers Cline and Brown

The appointment of Andrew M. Baker as store manager at Duncan, Okla., for the Oil Well Supply Division of United States Steel Corp.; transfer of Jack T. Cline, field representative, from Lindsay, Okla., to Healdton, Okla.; and transfer of Harry R. Brown, field representative, from Healdton to Oklahoma City have been announced by Mark Barkhurst, Mid-Continent area manager of the division.

Baker served at Seminole, Okla., Healdton, and Duncan. In 1953 he was appointed field representative at Oklahoma City, the position he held prior to his present appointment. Cline was employed in 1951 by Oilwell at Pauls Valley, Okla., and later served at Elk City, Okla., and Lindsay, being appointed field representative at the latter location in 1956. Brown joined Oilwell at Healdton in 1952 and was appointed field representative at this location in 1954.

Southern Engine & Pump Names Bedker to Sales Post

E. C. Bedker has rejoined Southern Engine & Pump Co. after an absence of 6 years and will represent the company in sales to the drilling and production divisions of the oil industry. Upon leaving Southern Engine in 1951, he became vice president of Fred Hintz, oil well service, at Dickinson, Tex. Bedker formerly was associated with Southern Engine & Pump from 1945 to 1951 in the Dallas office.

Infilco Elects Engel and Gustafson to Top Posts

At a recent meeting of the board of directors of Infilco, Inc., P. N. Engel was elected chairman of the board, and J. S. Gustafson was elected president.

P. N. ENGEL

J. S. GUSTAFSON

For 55 years Engel has been active president of Infilco, the firm being founded by his father in 1896. Engel left school to work in Chicago's Columbus laboratory. Later he joined Fuller & Fuller, then a leading distributor of heavy chemicals. In 1902 he became production, development, sales and engineering guide of the tiny International Filter Co.

Gustafson formerly was with Touche, Niven, Bailey and Smart, where he later became manager of the special services department, devoted to systems, procedures, and management consulting. In 1951 he became treasurer of Infilco and, in the following year, vice president of the company. In 1953 he became executive vice president, an office which he held until his recent election to the presidency of the company.

Continental-Emsco Holds Sales Meeting in Dallas

Continental-Emsco Co. recently held its first company-wide sales meeting since consolidation. The 3-day meet was held at Dallas, headquarters for the oil-field manufacturing and supply company.

Over 250 members of the organization from the United States, Canada and South America attended. Continental-Emsco is a division of The Youngstown Sheet & Tube Co. and was formed when the parent company consolidated Continental Supply Co. and Emsco Manufacturing Co. on January 1.

Shown at the banquet table: W. T. Powell, executive vice president, manufacturing and engineering, Continental-Emsco; J. L. Mauthe, chairman of the board, Youngstown Sheet & Tube; F. I. Brinegar (speaking), executive vice president, distribution, Continental-Emsco; F. M. Mayer, president, Continental-Emsco; W. J. Morris, retired chairman of the board, Continental-Emsco; and Walter E. Watson, vice chairman of the board, Youngstown Sheet & Tube.

Atlas Pipe Purchases Hardy-Griffin Engineering

The purchase of Hardy-Griffin Engineering Corp. by Atlas Pipe, Inc., has been announced by W. H. Becker, Atlas president. The two companies will continue to operate under their individual names.

Hardy-Griffin, which makes and installs tubing joint and seal ring inserts for oil-field tubular goods, has been in operation about a year. Atlas Pipe has been a distributor of oil-field casing, tubing and drill pipe since its organization 6 years ago. The main Atlas plant is in Houston with a branch at Corpus Christi.

Subject to approval by Hardy-Griffin stockholders, Atlas Pipe will buy all the assets of Hardy-Griffin in return for 60,000 shares of Atlas stock which will be distributed to Hardy-Griffin shareholders in exchange for their stock. A meeting of Hardy-Griffin stockholders will be held soon, W. B. Taylor, president, indicated.

Becker indicated that the Hardy-Griffin operation would continue under its present name, management and personnel, probably as a wholly owned subsidiary of Atlas Pipe, Inc.

Big National Pump Unit Works on Teas Deep Well

This big pumping unit, which seems to dwarf the man in front of it, is pumping 1A Slaughter owned by Paul C. Teas, the deepest well in Garza County, Texas. Running approximately nine strokes a minute at 86 in. per stroke, the unit is producing 9 bbl. per hour.

The well, 8,350 ft. deep, is lined with 5½-in. casing and uses 2-in. tubing, with National wellhead equipment. The pumping unit, also made by The National Supply Co., is a Type D-29SB-32ODW, powered by an 8½ by 10 Ajax engine. A 1¼-in. by 20 by 24-ft. Fluid Packed Pump is used in the well.

Leo Gude is gerenal superintendent and Jim Scarborough district superintendent for Teas.

Special Guests Attend Meeting of Houston Nomads

At a recent meeting the Houston Chapter of Nomads heard a description of operating problems in western Canada, given by Tom Gaines of Texaco Exploration Co., Calgary. Special guests for the meeting were: (standing) Alfredo Salinas, E.N.A.P., Punta Arenas, Chile; John B. Williams, Iraq Petroleum Co., Iraq; D. C. Wilkins, Qatar Petroleum Co., Iraq; Tom Gaines; Gary Prince, Edwin W. Pauley Co., Reynosa, Mexico; Tucker Pennington, Humble Oil & Refining Co., Houston.

Seated: Martin Newell, Tidewater Oil Co., Ventura, Calif.; Martin Mears, superintendent, STA, Turkey. Kneeling: W. L. Reynolds, Cameron Iron Works, Inc., Houston; and Don Harlan, The Texas Co., Houston.

McCullough Tool Opens Citronelle Service Branch

McCullough Tool Co. has recently opened a service branch at Citronelle, Ala., according to an announcement by O. J. McCullough, vice president. W. O. Cole, senior operating engineer, is in charge of this branch, which is fully equipped to serve the area with all wire-line services by McCullough Tool. D. C. Marler, Lake Charles, La., is district manager of this area.

Cott Heads Newly Formed Falcon Line Products Corp.

N. E. Cott has recently announced the formation of Falcon Line Products Corp. with headquarters at Pittsburgh, Pa.

The new company will operate nationally, offering a complete line of materials and equipment to the pipeline industry. Included will be pipeline felts and outer wraps, fiber glass inner wrap and hand-wrap materials, pipe shield, pipeline tapes, field jointers, insulating spacers and seals, holiday detectors, pipeline pigs, anodes and cathodic connections, line-travel equipment and other supplies.

Prior to forming Falcon Line Products Corp., Cott was northeastern division manager for Midwestern Pipeline Products Co., Tulsa.

New Sales Representative Named by J. F. Pritchard

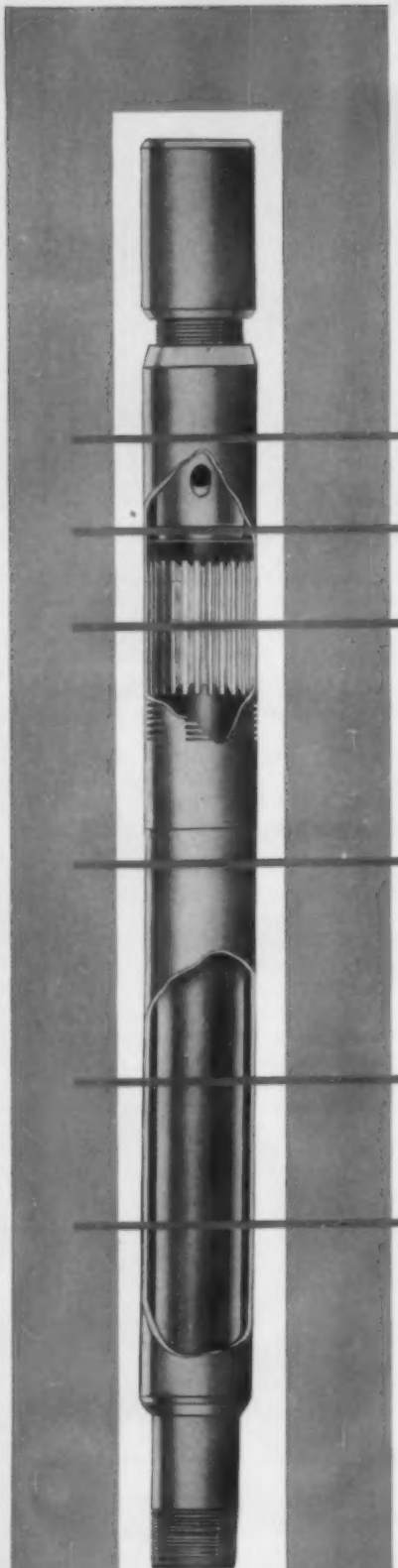
The Steel & Engineering Products Co., El Paso, Tex., has been named sales representative for New Mexico and the western tip of Texas by J. F. Pritchard & Co. of California, Kansas City, Mo.

Steel & Engineering Products was founded in 1947 by W. W. Small. The organization, with Small as principal, includes: Ivan Lockwood, in charge of the mechanical products department; John Toepfer, assistant to Lockwood in the El Paso office, handles sales development of mechanical products in southern New Mexico and West Texas; Albert Washburn, head of the construction products department, with his assistant Richard Lown, handles all sales to general contractors.

Stanley Avery, in charge of the Albuquerque office, originally coordinated all activities of the Lustron Corp. in the Los Alamos, N. M., area. He has represented Steel & Engineering Products in Albuquerque for several years and covers northern New Mexico.

Westcott & Greis Moves Sesock to New Mexico

Andrew J. Sesock, sales engineer for Westcott & Greis division of American Meter Co., Inc., has moved his headquarters from Billings, Mont., to Albuquerque, N. M., where he will cover the New Mexico sales territory,



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according to C. B. Dushane, Jr., American Meter vice president, sales.

Sesock has been with Westcott & Greis since 1951. Prior to that time he was with the sales and service department of Refinery Supply Co. Earlier he was assistant to the chief engineer of Refinery Manufacturing Co.

Mountain Iron Names Bouse As Sales Vice President

AL BOUSE

Appointment of Al Bouse as vice president in charge of sales for Mountain Iron & Supply Co. has been announced by S. O. Beren, company president. Bouse has served as general sales manager for the company since 1954. Bouse started with the firm as store superintendent in 1945. He became eastern area superintendent in 1953. He had 18 years of oil-field experience prior to joining Mountain Iron.

Serving immediately under Bouse as district sales managers are R. F. Miller of Wichita for the Kansas district with seven stores; Bill Frevert of Denver for the Rocky Mountain district with a store at Kimball, Neb.; and Gene Turner of Tulsa for the Oklahoma district with stores at Bartlesville and Pawhuska.

Southwest Supply Names West Texas Manager

B. I. (Bert) Castle, Jr., has been named district manager for the West Texas area of Southwest Supply Co. Castle was with Oil Well Supply from 1941 to 1952, representing it in South Texas, Rocky Mountain district and West Texas. Later he was with Bosworth Drilling Co. of Odessa.

Southwest Supply Co. was organized in 1911 and handles a complete line of oil-field supplies, including oil-country tubular materials.

Shaffer Tool Works Opens Shop, Office Facilities

Shaffer Tool Works has recently announced opening of its new shop and office building at Houma, La. Formal opening was held May 10 and was attended by oil-company officials and field personnel from a large section of the Gulf Coast and Tristate areas.

The new plant is located on Highway 90 approximately 3 miles east of Houma and is designed to give superior service to the oil industry in that area.

- Now exploratory wells can be drilled in the ocean, lakes and other underwater locations using inexpensive floating vessels or barges instead of the costly "islands" or platforms heretofore required.

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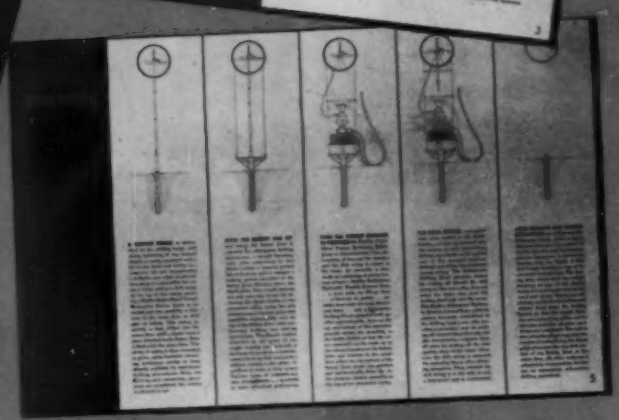

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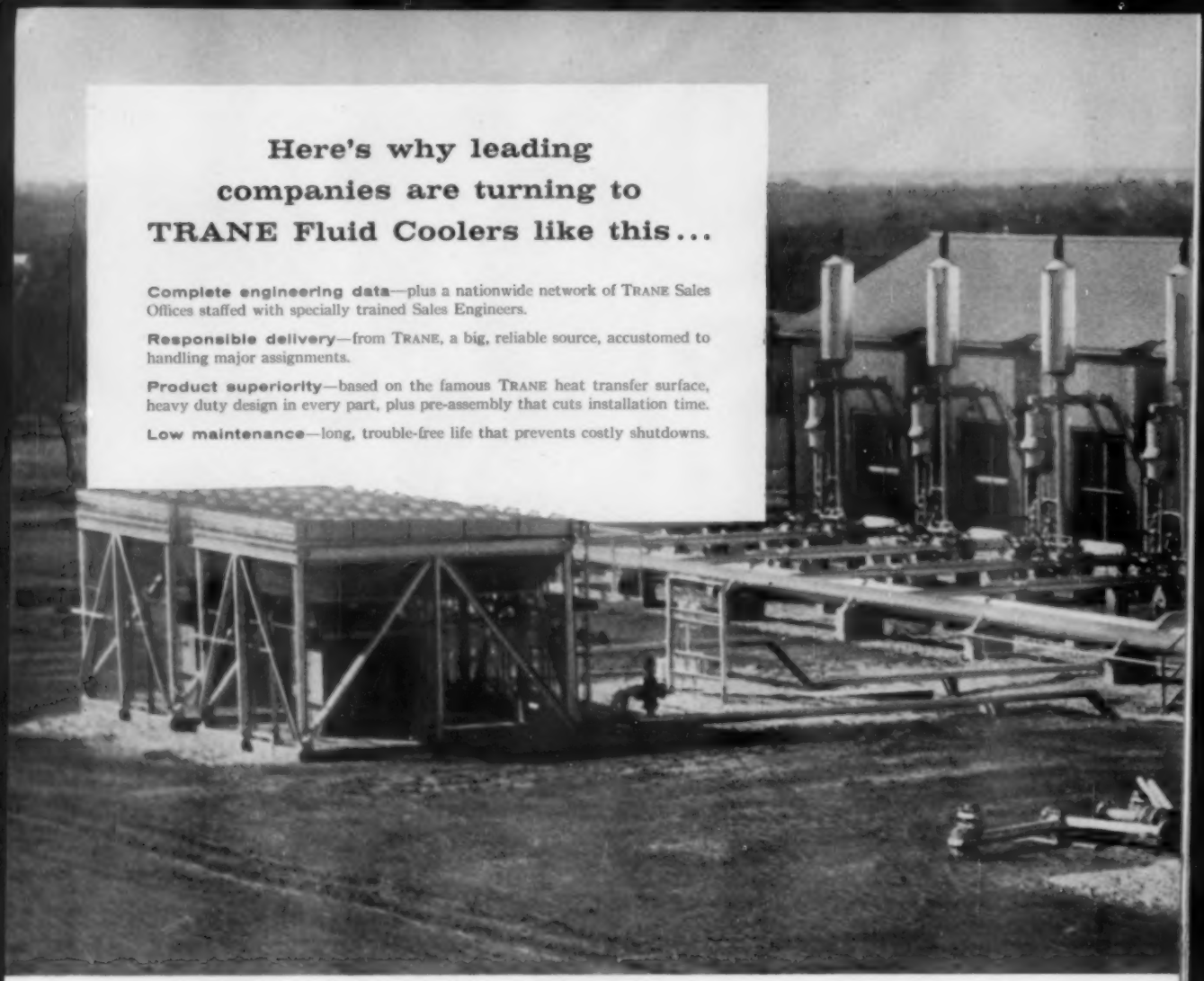

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Texas Eastern Transmission uses TRANE units for gas

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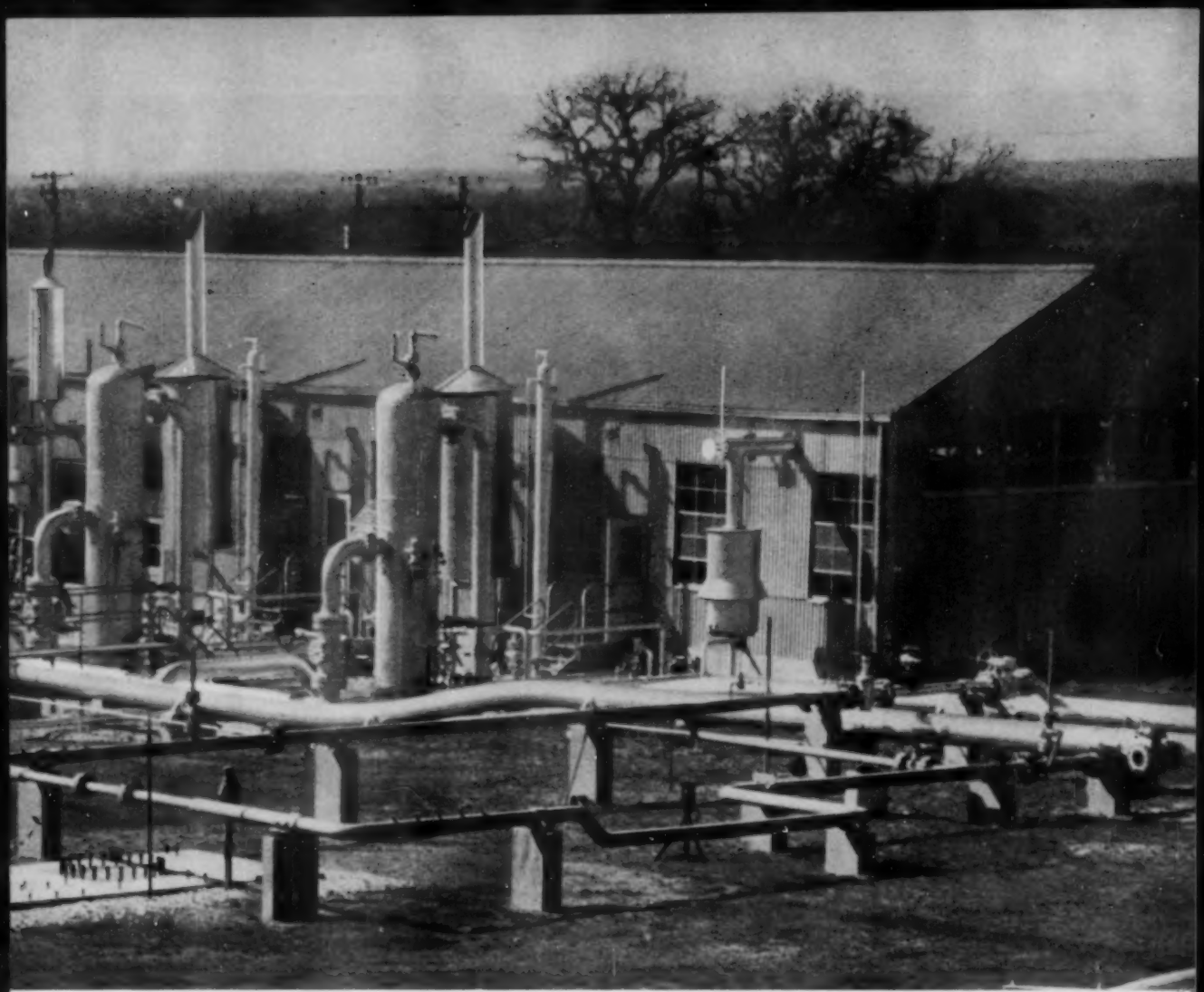
TRANE Fluid Coolers were selected for this important job—and TRANE Engineering Service provided complete detailed drawings and data.

Making equipment for cooling is TRANE's business. When you turn to TRANE, you draw on thirty years of experience with fans and coils under all types of operating conditions. That's why more and more pipeline companies are using TRANE Fluid Coolers; they've discovered that in TRANE they have a reliable source for well-designed, well-built equipment for their cooling needs.

What's your fluid cooling problem? For complete information on how TRANE can help, call your nearby TRANE Sales Office—or write TRANE, La Crosse, Wis.

These TRANE Fluid Coolers satisfy capacity requirements with unusually low hp requirements. Designs are based upon capacity and performance data secured from tests in wind tunnels in the TRANE Engineering Laboratories.

**Wilcox-Trend Gathering System, Inc. A subsidiary of Texas Eastern Transmission Corp. Engineering Contractors: Brown & Root, Inc.*



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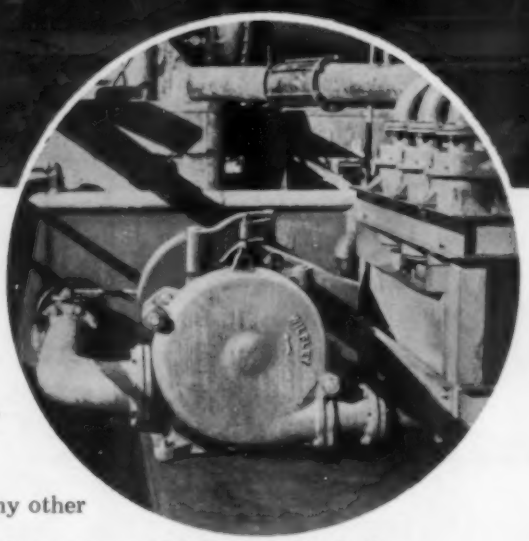

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RENEWED LEASING ACTIVITY and announcement of a deep wildcat in Prairie County, Arkansas, have awakened new interest in the oil and gas secrets of the Mississippi embayment. (Contours on top of Cretaceous, from Tectonic Map of the United States, by A.A.P.G).

Eastern Arkansas Stirring

by Frank J. Gardner

"DO you have any pet potential provinces in the back of your mind? A region, a basin, or even a small area that you believe **should** produce oil, but never has?"

That's a favorite question for nosy oil reporters to ask an oil finder. And the answers would fill a good-sized book. Very few people answer "No." Some say "Sure, but I'm not going to tell you!" But many will expound at great length on their pet provinces and their theories about why oil should be there.

A great downwarp . . . One of the most popular pet provinces is pictured on this map. It's the Mississippi embayment, northernmost part of the Gulf Coastal Plain. Through its central portion winds a great downwarp known as the Arkansas syncline, the deepest part of which is known in turn as the Desha basin.

To date, no oil or gas fields have been discovered in this region, but many hunters believe that it will eventually pay off. The greatest stimuli to the belief were the scattered successes of the early 1950's in the Black Warrior basin of northeastern Mississippi and northwestern Alabama . . . another potentially great oil and gas province that has failed so far to live up to expectations. The Black Warrior strikes led to increased interest in eastern Arkansas, but only a handful of deep tests were drilled, and exploratory ardor cooled quickly.

Sees renewed activity . . . Today, reports of aggressive lease blocking in the counties outlined on the map have again called attention to the Desha basin area. One company is said to be assembling a 2½-million-acre spread across Arkansas, Crittenden, Cross, Jackson, Lee, Prairie, St. Francis, White, and Woodruff counties in eastern Arkansas. A 9,500-ft. wildcat is pending for Prairie County, on the northwest flank of the downwarp; this will be drilled in Section 22-1s-4w by Panhandle Eastern Pipeline Co., near the center of a 24,000-acre block. If it should hit, there's little doubt that a major campaign would get under way. If it should not, the geological dope that it reveals will be a major contribution to our meager knowledge of the embayment.

The Mississippi alluvial valley presents a major obstacle to subsurface interpretation here. The potentially productive formations of Tertiary, Cretaceous, and Paleozoic age are completely masked by a Quaternary sequence and Recent alluvium. Many shallow wells have been sunk, especially in the twenties when the Louisiana-Arkansas play was at its height; and a few deep ones have gone down, but not nearly enough to shed any important light on subsurface conditions.

But it's still a riddle . . . Examination of early records turns up some interesting statistics on drilling, but that's about all. Up until 1937, only one oil show was recorded, and that was in 1908! Since then, drilling has lagged, but some deep holes have been drilled at intervals. In Arkansas County, for instance, Seaboard Oil Co. reached granite at 4,747 ft. in 1954; and in the same year, Magnolia Petroleum Co. 1 Sturgis, drilled in Woodruff County on seismic and core-drill surveys, quit in Jefferson City-Ordovician at 6,002 ft. In White County in 1952, Deep Rock Oil Corp. 1 Sample also found the Ordovician and reported subcommercial shows of gas in the St. Peter sandstone at 5,078 ft. In Desha County, in the deepest part of the basin, the Delta-Caribbean Oil Corp. test was abandoned in Eagle Mills-Jurassic at 5,296 ft. in 1954.

What the Desha basin holds for the oil finder, then, is a still-dark riddle. Many deep holes are needed before it can be written off. For when so many people believe in an area, history shows that eventually something comes of it. And lots of geologists have an unflinching belief in Desha.

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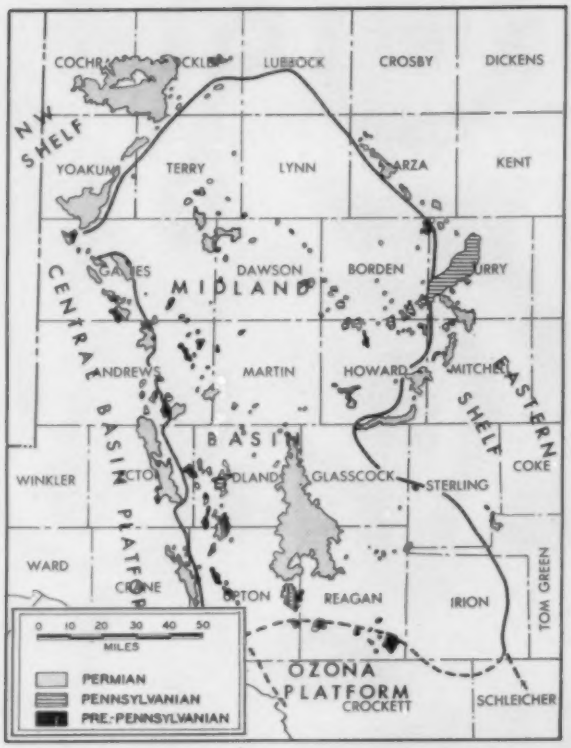
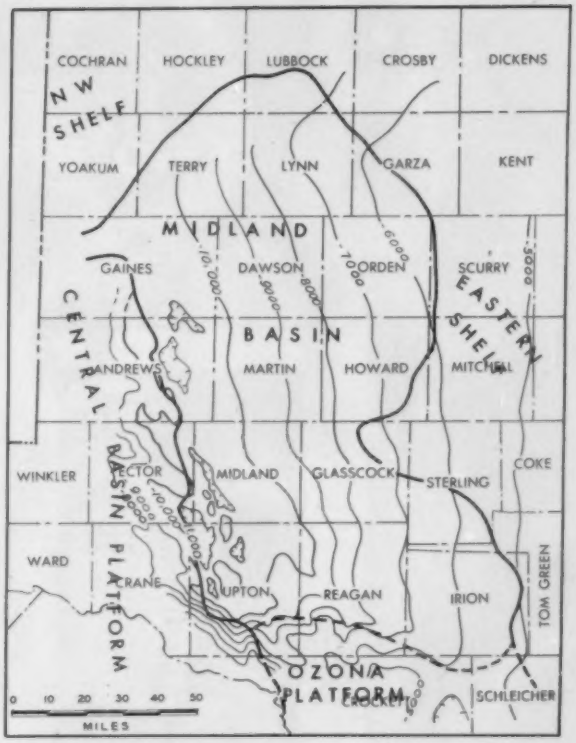


THE MIDLAND BASIN produces from both structural and strat traps. Exploration now is slanted toward finding strat traps. Fig. 1.



ELLENBURGER STRUCTURE defines the basin. In north-central Gaines County, Ellenburger may be absent. Fig. 2.

Structural discoveries are declining so . . .

Midland Basin Looks to Strat Traps

by William J. Thompson

IN THE past decade, the 13,000-sq. mile area occupied by the Midland basin has furnished many prolific oil fields. Both structural and stratigraphic traps produce. Such fields as Headlee, Dora Roberts, Virey, Warsan, Sweetie Peck, Pegasus, Benedum and Magutex, to name a few, have produced considerable oil and greatly increased reserves from traps of structural origin. The truly significant structural oil finds appear to be leveling off or declining. Many of the more recent discoveries have been made from single-pay low-relief anomalies, or structures with limited areal extent. Rather extensive seismograph surveys tend to minimize the possibility of locating new large undrilled anticlines.

Probably the most outstanding per-acre recoveries from a single producing horizon come from stratigraphic traps in the North Midland basin-Horseshoe atoll area, from fields such as Good, Vealmoor, East Vealmoor, Reinecke, Wellman and many others. With the reduction of structural types of oil discoveries, it is becoming increasingly more important to turn exploration efforts toward locating the elusive stratigraphic traps. Fortunately, late Paleozoic sedimentary environments in the Midland basin have provided a great variety of conditions permitting stratigraphic oil accumulation. The prolific reef production in the Horseshoe atoll area, along with reeflike carbonate developments and facies changes around the basin's rim, offer the most fertile areas for future Midland basin exploration.

Basin limits . . . The line defining the approximate Midland basin boundary (Fig. 1) is controlled by Permian stratigraphic conditions. These involve a change from a more clastic Permian section in the basin to a predominantly carbonate lithology in the adjacent geologic provinces. The boundary line is arbitrarily drawn midway between the maximum extent of the top of Spraberry and Dean facies. This sedimentary facies change can be recognized in most areas to the north, east and west; however, on the south, where the line is dashed, such definition does not exist. Permian clastic sediments continued

Author is with Continental Oil Co., Houton, Tex. Article originally presented at tenth annual Midwestern Meeting of the Society of Exploration Geophysicists, Fort Worth and is published here by special permission of the Society.

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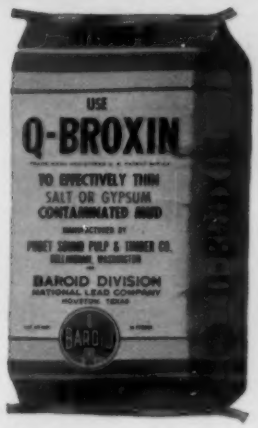

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CONTOUR MAP on top of the Mississippian resembles the Ellenburger (Fig. 2) although the structures are less pronounced. Fig. 3.

DASHED LINE represents change from a clastic facies to a typical shelf carbonate sequence in the Spraberry. Fig. 4.

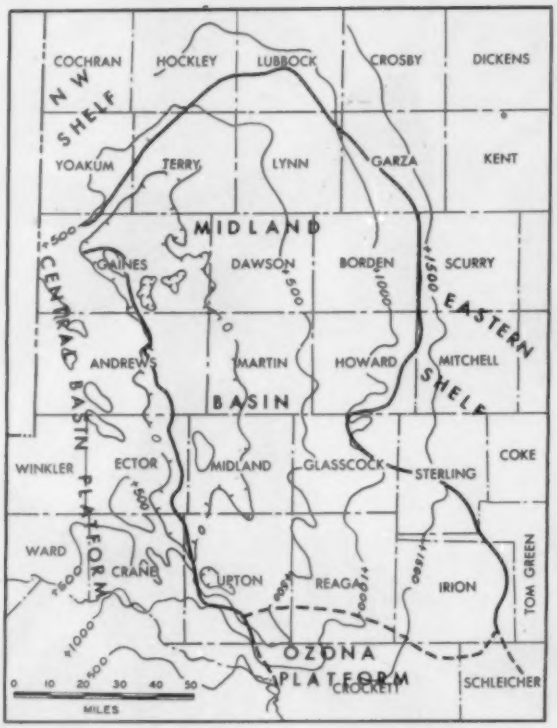
across most of the Ozona platform making a Permian stratigraphic boundary on the south practically nonexistent. The same is true to a lesser extent in northwest Gaines County where Leonard clastics can be traced westward across the Bone Spring Channel and provides a means of separating the Central basin platform from the Northwest shelf. A line has been dashed across the southern end of the basin merely as an arbitrary means of separating the Midland basin from the Val Verde basin, to the south, at a point along the north edge of the structurally high Ozona platform.

Structure . . . The subsurface map on top of the Ellenburger (Fig. 2) rather generally defines the asymmetrical elongate closed basin. This picture is characteristic of most mappable units of Permian age and older. The Ellenburger is missing locally along the northern end of the Central basin immediately adjacent to these areas. The dashed contour lines in North-Central Gaines County defines an area of sparse Ellenburger control and a zone where the presence of Ellenburger is questionable.

The sequence of events leading up to the eventual formation of this asymmetrical basin are rather complex. The first all-important regional orogenic type of stresses to influence the ultimate shape of the Midland basin and Central basin platform were applied in early Pennsylvanian time. This is also the approximate date of the orogenic deformation that formed the Wichita and Arbuckle Mountains in southern Oklahoma and the buried Amarillo Mountains of the Texas Panhandle. Not only is the age relationship similar but all three of the areas, with a few exceptions, have the same general northwest strike. The compressive forces squeezed the pre-Pennsylvanian sediments into a series of anticlinal structures that trapped a major portion of West Texas petroleum. Most of the well defined compressional structures are situated on the Central basin platform. However, many of the anomalies trend into the Midland basin, primarily in the west and southwest. The structures in most instances are larger, on or near the Central basin platform; they appear to decrease in magnitude in a north and easterly direction away from the platform.

The original position of many Midland basin structures must have been nearly flat to the Central basin platform but later diastrophism lowered them relative to their former position. Sometime during the Pennsylvanian period, at the conclusion of the main orogenic disturbances, a trough having a more northerly strike than the trend of the anticlinal features of early Pennsylvanian time started to develop along the present axis of the Midland basin. The general strike of the Permian and late Pennsylvanian rocks of the downwarped feature can probably be attributed to epeirogenic type of stresses. These resulted from submergence which probably began in the Pennsylvanian and reached their climax in Permian time.

Many areas of maximum downward movement are best outlined by the 11,000-ft. subsea contour line. This zone of weakness along the westernmost edge of the Midland basin provided an almost continual depression for sedimentary accumulation. The resulting pronounced variation of the sea floor along the Central basin platform-Midland basin boundary certainly influenced the Pennsylvanian and Permian sedimentary environments. It is along this anomalous unstable basin-platform trend where the pronounced clastic-carbonate facies change takes place. Evidence to support gradual submergence contemporaneous with deposition is probably best displayed along the western boundary of the basin. Here Leonard sediments in the trough are several hundred feet thicker than a platform equivalent a few miles to the west.



ALTHOUGH the relief is less, the Yates normally reflects the deeper structures. This may be due to differential compaction. Fig. 5.

The Mississippian subsurface map (Fig. 3) points out the relationship between the eroded top of Mississippian and the Ellenburger map. The general appearance is the same. However, the Mississippian regional dip is more gentle, especially along the east flank of the basin where Ellenburger in the Dawson-Borden County area dips approximately 70 ft. per mile, and the Mississippian dip is 55 ft. per mile.

Fig. 4 shows a subsurface map contoured on top of the Spraberry sand. In this illustration the dashed line defines the approximate zone where the mapped top of the Spraberry facies changes from clastic to a typical shelf carbonate section. This type of facies change can be recognized in many post Mississippian sedimentary units and perhaps best defined in the Wolfcamp and Leonard sections. A map on top of the Dean sand would look very similar, but in most instances the facies would change to carbonate east of the top of Spraberry pinchout. This appears to hold true throughout most of the basin leading to the conclusion that the older Permian rocks facies grade out to the east and the progressively younger beds to the west. This could be termed a regressive facies change on the east edge of the basin and a transgressive type of facies change along the basin's west rim.

Perhaps the best explanation of such facies migration would be a gradual lowering of a point to the west of the Midland basin. Such a position would be near the major axis of Permian sedimentary accumulation of the submerging South Permian basin.

Although the Midland basin is a geologic province having characteristic differences from adjacent provinces, it is difficult to consider its tectonic and sedimentary history without evaluating this over-all sequence of events for surrounding areas. This facies migration of Spraberry and Dean is possible evidence of the downwarping of the entire South Permian basin.

On top of the Yates . . . The subsurface may contoured on top of the Yates (Fig. 5) shows much less relief than the Ellenburger and Mississippian maps. Yet it retains the same general regional structural appearance. The Permian often reflects older anomalies, but the amount of closure over these features will often decrease as a younger horizon is mapped. The subsurface map on top of the Yates helps to illustrate how relief has decreased from the Ellenburger and Mississippian to the more gently dipping Spraberry to the shallow Yates sandstone. The reflection of older anomalies by the Yates can probably be attributed to differential compaction within thousands of feet of Permian sediment.

Stratigraphy

The columnar section (Fig. 6) was constructed from sample and electric log data from the Skelly 1 Means. This well is believed to be representative of the stratigraphic section along most of the deep western edge of the basin. The section is generalized but probably indicative of a large part of the Midland basin stratigraphy. An electric log is included to show the electrical characteristics for many of the formational boundaries relative to the lithologic section. The following is a brief discussion of some of the characteristics of these stratigraphic units:

- The Lower Ordovician Ellenburger is the oldest-producing horizon in the basin. It generally consists of a highly fractured and solutioned sandy and siliceous dolomite and lesser amounts of limestone. The section thins to the north and east and has been removed probably by erosion, locally in the basin, in many places just beyond the north rim of the Midland basin and in many structurally high areas to the west. A rather pronounced disconformity exists between the Ellenburger and Simpson. Some deep wells along the western margin of the basin show evidence of a possible Karst type of topography with Simpson sediments filling the solutioned features. The Ellenburger produces oil from most structural traps in the Midland basin.

- The Middle Ordovician Simpson consists of medium to coarse-grained quartz sandstone, limestone and varicolored shales. The section thickens to the southwest, reaching a maximum of approximately 2,000 ft. in Northwest Pecos County. The Simpson thins to the north and east and finally wedges out along a line running northwest-southeast, just west of the middle of the basin. In most areas north and east of the pinchout, Montoya rests on Ellenburger, probably indicating pre-Montoya erosion.

- The Upper Ordovician Montoya formation is made up of siliceous limestone and dolomite. The section thickens to the west and thins eastward, pinching out just basinward from the north and east boundaries of the Midland basin.

- The youngest Ordovician is represented by the light greenish-gray pyritic Sylvan shale. This shale unit is too thin to be noted on this rather generalized columnar section; however, it is believed to be present and has a thickness of 5 to 10 ft. separating the Montoya from the Fusselman. Sixty or more feet of Sylvan is present along much of the eastern part of the basin.

- The Silurian and Devonian systems have been grouped together and called Hunton. In many places in the Midland basin it is difficult to make an age differentation of the dolomite often characteristic of this group; however, where a fossiliferous limestone is present the separation of the systems is more accurate. The Hunton is present

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over most of the basin and wedges out near the eastern extremity along a line from Northeast Terry County, Northeast Dawson County, through East Howard and West Sterling counties. The Hunton makes a good oil reservoir in many of the structural traps in the Midland basin.

Between Woodford and Devonian time, epeirogenic forces were responsible for uplifting of a point to the east of the Midland basin. This resulted in an angular unconformity between Woodford and older rocks. The Woodford has apparently transgressed older formations so that over most of the basin it will rest on Hunton, Montoya and Ellenburger. The Woodford lithology is predominantly dark brown to black pyritic and sporaceous shales.

● All four series of the Mississippian system are believed to be present in most of the Midland basin. The lowermost unit of Kinderhook age contains limestone, sandstone and locally green shales. Perhaps the basal section consists of brown to black carbonaceous shales from the Woodford. Above the Kinderhook is a brown argillaceous and siliceous limestone termed the Mississippian Siliceous limestone, or often lower Mississippian limestone. Above this unit is the Barnett black shale. South of the well, used in this columnar section, the lower Mississippian limestone gives way to black shale facies. North of this well, the top of the black shale facies changes to a cleaner siliceous limestone sometimes called the upper Mississippian, or Chester limestone. The black shale section continues to facies out and give way to the upper and lower limestone units toward the north part of the basin.

● An angular unconformity exists between the Pennsylvanian and Mississippian in the Midland basin area. The unconformity is quite obvious where the pre-Pennsylvanian section has been severely eroded on the adjacent platforms and not so apparent in the more negative basin. The columnar section shows Atoka on Mississippian with Morrow missing. The absence of Morrow over much of the Midland basin would indicate the area was positive and perhaps being subjected to early Pennsylvanian compressional stresses. The Atoka lithology consists largely of black shale, argillaceous and siliceous limestone, and arkose in many areas in the north half of the basin.

● A rather clean fossiliferous and often siliceous lower Strawn limestone of the Des Moines series occupies a position over rocks of Atoka age. A minor unconformity probably separates the Strawn from older sediments over the basin's east margin, but evidence for a hiatus is not obvious and may not exist along the trough to the west. The dark shale unit immediately above the lower Strawn limestone has recently provided, what are believed to be, lower Strawn fusulines from a core in Martin County. If true, this puts the Pennsylvanian-Des Moines series directly beneath the Wolcamp series of Permian age, and the Cisco, Canyon and upper Strawn apparently are missing over much of the basin. However, the Horseshoe atoll area in the north part of the basin has outstanding but irregular distribution of Strawn, Canyon, Cisco and Wolfcamp reefing. The upper Pennsylvanian and Wolfcamp lithology along the Central basin platform and Northwest shelf provide an exceptionally fine section of reef-like carbonates; in some localities these are quite porous and permeable and make good oil reservoirs. Basinward from these carbonates in most areas are the argillaceous limestones and calcareous dark shales of Wolfcamp age. The Dean sand of the upper Wolfcamp age is a good continuous mappable unit throughout most of the basin. The Dean is often referred to as a sand, but over most of the Midland basin it could be better described as a gray to brown siltstone.

The contact between the Wolfcamp and Leonard series of the Permian system is poorly defined, but has been

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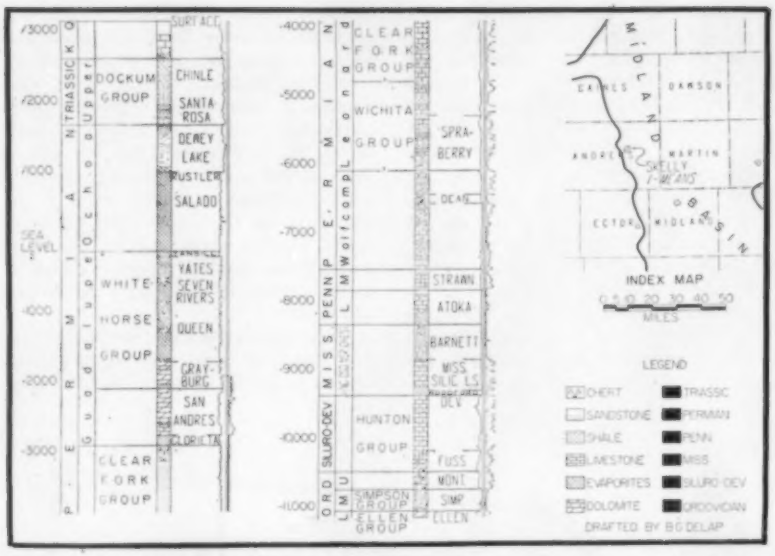

THIS ELECTRIC LOG is typical of the section in the deeper part of the Midland basin. Fig. 6.

conveniently placed at the base of Spraberry. Fusulines believed to be of Wolfcamp age have been recognized in the argillaceous limestone between the Dean and Spraberry clastics. The Spraberry has surprisingly consistent lithology throughout most of the Midland basin. It is subdivided into two rather well defined units, the upper and lower Spraberry sands, which are separated by brown argillaceous limestone. These Spraberry clastics and argillaceous limestones in the basin undergo a change to cleaner carbonates shelfward, except to the south, where the clastics continue over the Ozona platform. The upper Leonard section, sometimes referred to as the Clearfork group, consists largely of dark shales, argillaceous limestones and a locally thick calcareous sandstone section along the basin's western trough. Again these clastic facies change to clean carbonates toward the more stable shelf areas.

● The basal Guadalupian Glorieta formation in the well selected for this columnar section appears to correlate with a platform Glorieta facies and the Leonard-Guadalupian contact has been placed at the base of this correlative unit. The calcareous sand body at the top of the Leonard will rapidly change to what is believed to be a Clearfork carbonate facies to the west.

● San Andres lithology is quite varied, generally a dolomite but commonly made up of limestone, sandstone stringers, sandy and anhydritic dolomites, all of which occupy a position directly above the Glorieta. San Andres carbonates have produced considerable oil in the basin proper and is even a more prolific producing horizon immediately adjacent to the basin boundaries.

● The Whitehorse group occupies a position above the San Andres. The Grayburg formation is the basal unit of the Whitehorse and consists mainly of dolomite, sandstone and anhydrite. The younger Whitehorse formations consist of evaporites and sandstones with scattered dolomite units. The Queen sandstone of the lower Whitehorse group has attracted considerable attention in the past 2 years with its prolific production along the west edge of the basin Northeast Andrews and Southeast Gaines counties. Overlying the Queen sand are the Seven Rivers dolomite and evaporites. The Yates occupies a position above the Seven Rivers and immediately below the Tansill anhydrite and dolomite. The abrupt lithology change between Tansill and Yates makes the contact easy to recognize in sample and electric logs. Its shallow depth, widespread ease of recognition, penetration by the vast majority of wells drilled, and the fact that it very commonly reflects older anomalies makes the Yates a very outstanding mapping horizon.

The youngest Permian represented in the Midland basin is the Ochoa series, consisting of the Salado and Rustler evaporites, and the uppermost Dewey Lake sands, silts and shales.

Capping the Permian in the Midland basin are rock outcrops of the Triassic, Cretaceous and Quaternary systems.

Production

Fig. 1 shows the producing fields of the Midland basin and surrounding areas. The various patterns outline the geologic age of producing horizons. The map is approximately 2 years old and many of the recent discoveries and field expansions are not shown.

Permian Features

The fields producing from pre-Pennsylvanian reservoirs most commonly make oil from structural type of traps. These probably had their origin during the early Pennsylvanian orogeny. Many of the Permian anticlinal features associated with these structural traps are believed to have developed by differential compaction over the compressionally formed Pennsylvanian anticlines. This would indicate that the controlling factor responsible for practically all younger producing horizons associated with pre-Pennsylvanian reservoirs has an indirect relationship to early Pennsylvanian orogenic stresses. Most of the remaining fields producing in the basin, not associated with the pre-Pennsylvanian reservoirs, are either untested below the Pennsylvanian or the oil accumulation is related to stratigraphic conditions.

Most of the Permian production just beyond the basin's border is from the San Andres. Many of the San Andres fields will make oil from a reeflike biohermal carbonate development on which closure can be mapped. In some instances, San Andres closure results from draping over an older stratigraphic feature commonly of Clearfork, Wolfcamp or Pennsylvanian age.

The area of greatest Pennsylvanian oil accumulation occurs in the northern part of the basin. Here the arcuate trend of Permian and Pennsylvanian production helps to outline the Horseshoe atoll. The atoll area is a rather outstanding stratigraphic feature involving as much as 2,600 ft. of biohermal reef buildup in carbonates of Pennsylvanian and Wolfcamp age. Many of the fields situated on this reef have limited areal extent, but prolific reservoirs provide exceptional recoveries for carbonate rocks. By far the most outstanding feature along the atoll trend is the Scurry reef located just beyond the Midland basin border in Scurry County.

Acknowledgments

The author is indebted to Continental Oil Co. for permission to publish this information, to many of the people in Continental's Midland division for their assistance and, especially, C. D. Vertrees, regional research geologist, for use of the Mississippian map and for his constructive criticisms. Credit is due to the West Texas Geological Society Stratigraphic Problems Committee for their recommendations during the construction of the columnar section. **End.**

EXPLORATION

APPALACHIAN

OHIO

Gratiot pool was extended further east by Robinson et al 2-W. Higginbottom, 3 Qr. Hopewell Township, Muskingum County, which logged the Clinton at 3,248-3,312 ft. with 59,000 cu. ft. gas and 10 bbl. oil natural and made 145,000 cu. ft. gas and 630 bbl. oil first 24 hours after fracture. In the same pool, an offset by Pan Oil Co. 3-V. Idan, Section 21, Hopewell Township, Licking County, logged the Clinton at 3,130-42 ft. and 3,154-66 ft. with 35,000 cu. ft. gas and 4 bbl. oil natural and made 126,000 cu. ft. gas and 112 bbl. oil first 24 hours after fracture.

- An offset in North Royalton pool, Ohio Fuel Gas Co. 1-B. Burda, Section 7, Royalton Township, Cuyahoga County, gaged the Clinton at 3,101-12 ft. with 744,000 cu. ft. natural and 2,240,000 cu. ft. after fracture.
- Jebb Oil & Gas Co. 4-U.S.A., 4 Qr. Madison Township, Licking County, offset in Marne pool found the Clinton at 2,579-2,609 ft. with 25,000 cu. ft. gas and 10 bbl. oil natural and made 119,000 cu. ft. gas and 300 bbl. oil first 24 hours after fracture.

PENNSYLVANIA

In Armstrong Township, Indiana County, southwest Pennsylvania, T. W. Phillips Gas & Oil Co. 5 G. W. Uncather, wildcat, elevation 1,457 ft., had a final open flow of 1,300,000 cu. ft. gas, after fracture. Onondaga 7,550 ft., chert 7,568 ft., gas 7,626 ft., Oriskany sand 7,718 ft., gas 7,718 ft. Total depth 7,750 ft.

- In Washington Township, Columbian Carbon Co. 1-1844 Silas C. Streams, at 7,487 ft., shut down to move off rotary and move in cable tools.
- In White Township, J. C. Walker 1 Appalachian Coal Co. is drilling at 1,192 ft.

WEST VIRGINIA

In Green Bank district, Pocahontas County, West Virginia, Columbian Carbon Co. has located 1-1265 U.S.A. Dept. of the Interior wildcat, elevation 3,394 ft. It is on the Spruce Knob Quadrangle, 2.45 miles south of latitude 38 degrees 45 minutes and 4.45 miles west of longitude 79 degrees 45 minutes.

EASTERN KENTUCKY

Kentucky West Virginia Gas Co. has completed 6367 William Mullins et al on Lick Fork of Beefhide Creek in Pike County as a 50-bbl. per day oil well from Mississippian Big Lime. Well was initialed natural from 2,548-69 ft. TD., with top of formation logged at 2,245 ft. Casing head elevation was 1,194 ft.

CALIFORNIA

Stenderup Extension Misses

Union Oil Co. failed to extend production an additional 1,000 ft. northwest of Stenderup pool's most northerly producer in Mountain View field, Kern County. After taking the test, 33-21 Union - Hancock - Bowlus-Schuman, to 10,662 ft., Union plugged it back to 420 ft. and has suspended operations. The rig was moved off to a new location about 1,200 ft. south of the suspended well where it was drilling ahead below 2,100 ft. on 35-21 Stenderup in NE SW 21-31s-29e.

Hancock Reports Good Test at West Bellevue

Hancock Oil Co. reported its 53-33 Easton flowed oil on a drill-stem test at an unestimated rate for 5 minutes and then was shut in for an apparent successful northeast extension of Superior Oil Co.'s Bellevue West field discovery of last February. The interval tested by Hancock was 7,591-7,720 ft. This corresponds with the Upper Stevens sand production found by Superior with 44 WescO-Clark at 7,698-7,720 ft. in SE NW 33-29s-26e. In addition to the Hancock well, which the operator was drilling ahead after the test, to a projected depth of 8,350 ft., Superior has an extension well drilling about ½ mile southeast of the discovery. The Superior well, 86-33 Easton, was below 8,512 ft.

Edison Test Successful

Rothschild Oil Co. completed 6 Omaha as the first northerly extension to Western Gulf Oil Co.'s deeper pool discovery last January in the Edison field, Kern County. The Rothschild well was brought in flowing 2,000 M.c.f. daily of gas and 40 bbl. daily of 74.3°-condensate through a 8/64-in. choke. The producing interval at 5,190-5,200 ft. is equivalent to the Jewett sand of Edison field and equivalent to the upper zone of Western Gulf's discovery.

CANADA

ALBERTA

Kaybob Looms as Major Discovery

The Phillips Petroleum Co. oil strike in the Kaybob area of central-west Alberta is shaping into what may become one of western Canada's major finds. Latest report on the well stated that 140 ft. of oil-bearing structure had been opened up in the Middle Devonian-Slave Point horizon and coring and testing operations were continuing deeper in the formation with no evidence of formation water as yet. The well lies in wildcat territory, 35 miles west and 6 miles south of the Home-H.B.-Union 9-20 Virginia Hills Slave Point oil discovery well, 140 miles west-northwest of Edmonton and 90 miles southeast of Grande Prairie townsite. One of the latest drill-stem tests run at the venture, Phillips 1 Kaybob, on LSD 7, 22-64-19w5, flowed oil at a very favorable rate of 110 bbl. per hour; while latest test released again flowed oil but due to a packer leak, no gage was taken on the flow rate.

The well is being drilled by Phillips on acreage farmed out to it by the British American Oil Co., Ltd., and the California Standard Co. Phillips by drilling the well to the pre-Cambrian formation can earn an undisclosed interest in a portion of the 92,160 acres covered by Petroleum and Natural Gas Reservation No. 1994.

Initial drill-stem test in the horizon was of the interval 9,574 to 9,600 ft. Oil sprayed to surface in 40 minutes and hourly rate was 10 bbl. of 42°-gravity crude. Next test meanwhile, took in the interval 9,572 to 9,625 ft. and the high flow rate was encountered on that test evaluation, while latest test run between 9,625 and 9,675 ft. flowed oil to the surface and total flow and pipe recovery consisted of 45 bbl. of oil and 10 bbl. of mud during the 37-minute test. Crew is currently bottomed at 9,725 ft. and coring operations

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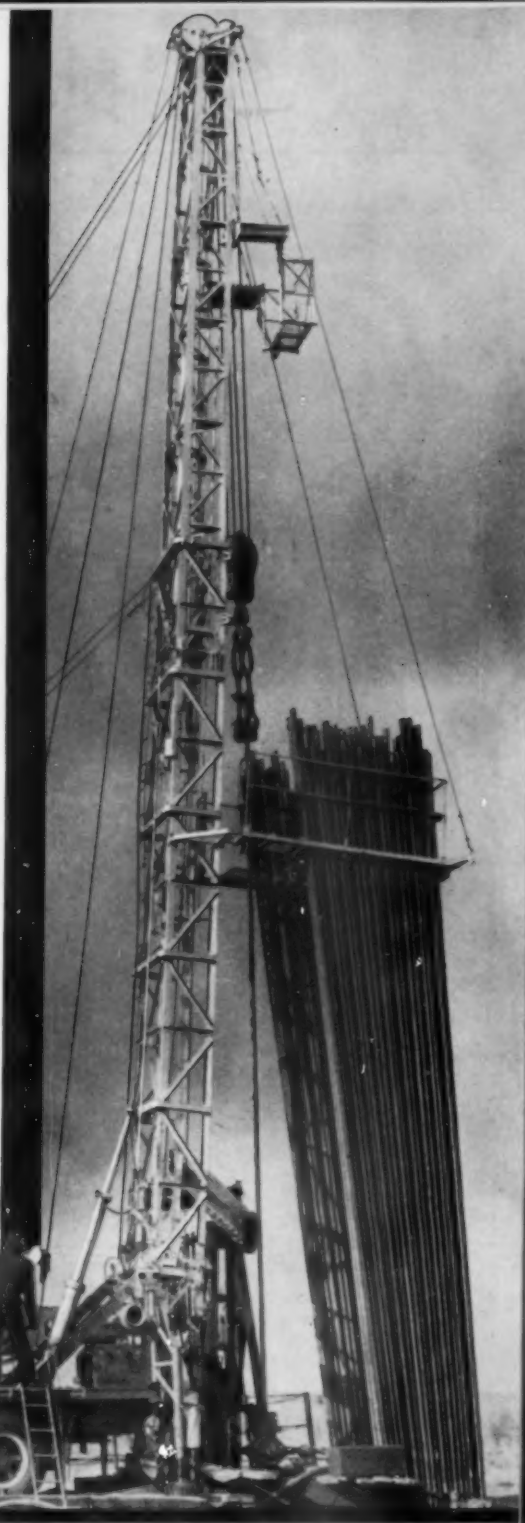

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JURASSIC		→	———	Fosterton Midway Cantuar Eastend Wapella Frontier Gull Lake Rapdan Loomis Leon Lake Dollard	———	———	———
TRIASSIC	Spearfish	→	———	———	Fryburg South Westhope	———	———
PERMIAN	NO PRODUCTION IN BASIN FROM PERMIAN						
PENNSYLVANIAN			NO PRODUCTION IN BASIN FROM PENNSYLVANIAN				
MISSISSIPPIAN	Big Snowy Gp. Heath	→			Rocky Ridge Bellfield Fryburg		
	Madison Gp. Charles			Midale	Bottineau County		Poplar
	Mission Canyon	→	Waskada Coulter	Ratcliffe Forget Midale Moose Frobisher (others)	Nesson anticline Bottineau County Newburg Bluell Columbus Coteau Flaxton Noonan	———	Richey Wolf Point
	Lodgepole	→	Daly Virden-Roselea Tilston Lulu Lake Whitewater	———	Bottineau County	———	———
	Bakken (Sanish sand)	→	———	———	Sanish Antelope	———	———
DEVONIAN	Three Forks	→	———	———	Beaver Lodge (shows)	———	Southwest Richey
SILURIAN	Interlake	→	———	———	Beaver Lodge (shows)	———	Outlook Sand Creek Southwest Richey North Richey
ORDOVICIAN	Red River	→	———	———	Beaver Lodge	Buffalo	Outlook Brorson Cedar Creek anticline fields

HERE IS A FORMATION-FIELD-AREA CORRELATOR of the Williston basin. Oil and gas production is found in rocks from Ordovician through Lower Cretaceous. The Mississippian Madison group is the basin's biggest producer. The two newest big producers are the Silurian and Ordovician in northeastern Montana's Outlook area.

are under way, after which the hole will be conditioned and a further drill-stem test carried out. Porosity at the well in the pay sector is rumored to be three times as productive as that which was encountered at the Redwater D3 oil field.

Mississippian Oil Found At Whitecourt Wildcat

Another well in the Whitecourt area of central-west Alberta, being operated by Canadian Fina Oil, Ltd., on behalf of itself, Canac Hudson's Bay Oil & Gas Co., Ltd., and the Pan American Petroleum Corp. has struck oil in the Mississippian formation. The team's newest find was recorded at the 10-21 Windfall driller on LSD 10, 21-59-15w5, 1 mile southwest of the 11-87 Windfall well that also indicated oil success in the Mississippian, but was completed as a potential gas producer in the D3 horizon.

Oil flowed to the surface during the test in the Mississippian, which was topped at 6,702 ft. and there was 6,800 ft. of clean oil in the drill pipe upon completion of the test that was bottomed at 6,835 ft. Upon completion of the test a further core was cut and at last report crew was preparing to run another drill-stem test.

The team's exploration and development program in this area stretches over a land spread in excess of 1,100,000 acres including 11 separate Petroleum and Natural Gas Reservations. Major portion of exploration on the rights to date has been carried out on Reservation No. 1453 on which the 12-36 Windfall D3 gas discovery well was drilled. The new discovery also lies on that tract which is on the eastern side of the team's huge land spread.

ILLINOIS BASIN

WESTERN KENTUCKY

Big Well Completed North of Utica

In Daviess County, 1 mile north of Utica, Green Valley Drilling Co. completed its 2 Charles DeLacey, 12-N-29, for a pump capacity of 400 bbl. per day. Production is from the Jackson sand at 1,316-36 ft.

KANSAS

SOUTHWEST KANSAS

Morrow Gas Pool Opened in Morton

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Pennsylvanian gas producing area. The discovery well of this new field is Colorado Oil & Gas Corp. 1-24 Hayward in C NE 23-31-42, 2 miles southeast of Sparks gas field.

The well flowed 10,617 M.c.f. of gas per day from perforations in the Morrow sand at 5,196-5,208 and 5,221-28 ft.

NORTHWEST KANSAS

Strap Trap Test Due Cambridge Arch

Great Basins Petroleum Co. of Denver and Los Angeles, has made location for 1 Commercial Bank, NW NW SW 23-1s-27w, Decatur County, Kansas. This well is the first of a two-well program designed to test a large stratigraphic trap in the wedge-edge of the Arbuckle dolomite and the Reagan sandstone. The Lansing-Kansas City groups and the lower Cherokee sands are secondary objectives. The well will bottom in granite at an estimated depth of 3,850 ft. It is located about 10 miles northeast of Oberlin, Kans.

LOUISIANA

SOUTH LOUISIANA

Gap Discovery May Link Two Iberia Parish Fields

A possible linking of Little Bayou Pigeon and Bayou Pigeon fields, in the narrow eastern arm of Iberia Parish, is indicated by a gas-discovery by Berkshire Oil Co. midway between the two fields.

Little Bayou Pigeon field, discovered by Continental Oil Co. early in 1955, is less than 2 miles northwest of Bayou Pigeon field, opened by Plymouth Oil Co. in 1940.

Berkshire's discovery well, 1 Jeanerette, in 12-12s-10e, is productive from casing-perforated interval at 12,183-88 ft. It had been drilled to 12,315 ft. Potential tests through 11/64-in. choke rated it good for 2,700,000 cu. ft. of gas and 65 bbl. of 49°-gravity condensate per day. Pressure touched 4,125 psi.

Little Bayou Pigeon field is productive from a 7,400-ft. sand. Bayou Pigeon produces from 8,000-8,100 ft. sands. Production of both is oil.

Lake Boeuf Extension Uncovers Deeper Pay

Pan-American Petroleum Corp. and Monterey Oil Co., joint operators, have a new oil-discovery well in the Lake Boeuf area, north of Raceland, in Lafourche Parish.

It is their 2 State Lease 2374, in Lake Boeuf, which flowed at the rate of 432 bbl. of 33°-gravity oil per day while testing through 5/32-in. choke. Flow was with pressure of 1,750 psi. and gas-oil ratio of 725 cu. ft. per bbl.

Production is from perforated interval at 13,122-30 ft. in 172 ft. of Miocene pay, topped at 13,030 ft.

Location is a mile west of these operators' discovery well. 1 Bowie, completed last October from perforations at 12,701-12 ft.

Initial well on the state lease was abandoned as a dry hole at 10,800 ft. It was drilled early in 1956.

The two operators share in a 4,550-acre lease block in the immediate area.

Lake Barre Joins Fields With 16,000-Ft. Production

Lake Barre, in Terrebonne Parish, last week joined the list of Coastal Louisiana fields with production below 16,000 ft. Four other fields are on the list. Lake Barre's new deep pay ranks third in depth.

Its discovery was by The Texas Co. at its 38-1 Louisiana Land & Exploration-State of Louisiana Unit. Pay is perforated at 16,303-26 ft. The discovery extends production more than a mile off the south flank of the dome. Total depth was 16,573 ft.

Tested through 11/64-in. choke, the well flowed at the rate of 346 bbl. of cle an,45.4°-gravity oil per day. Flow was under pressure of 4,950 psi. Gas-oil ratio was 7,127 cu. ft. per barrel.

MICHIGAN

Dundee Oil Zone Logged At Gladwin County Well

Muskegon Development Co. logged a Dundee oil pay at a wildcat well located about 2 miles southeast of the developed Billings oil pool at the 1 State-Billings, SW SW SE 12-17n-1e, Billings Township, Gladwin County.

On the basis of preliminary tests before acid treatment well appeared to be typical of Dundee wells in the original Billings pool, rated good for from 11 to 15 bbl. of oil a day natural. Well was being acidized with 4,000 gal.

Dundee top was logged at 3,454 ft. Pay showed at 3,540-45 ft. with a possible increase logged between 3,555-58 ft. Hole was bottomed out at 3,582 ft., total depth.

Wildcat was drilled on acreage farmed from Socony-Mobil Oil Co., Inc. Socony retained the west, southwest, south and southeast 40-acre offsets to this new discovery.

MISSISSIPPI

Fourth Pay Indicated In Hosston Test at Bolton

A Hosston-sand discovery virtually is assuring Bolton field, in western Hinds County, its fourth Lower Cretaceous pay. Paluxy, Mooringsport, and Rodessa zones already have proved productive. Original and more extensive pay is the Paluxy.

The Hosston discovery is by Weston Drilling Co. at its 6 Gaddis Garms, in 13-6n-3w, in the north part of the field.

Testing Hosston perforations at 11,794-98 ft., the well flowed at the rate of 260 bbl. of 43°-gravity oil per day through 5/32-in. choke. From perforations at 11,676-11,721 ft., flow was at the rate of 198 bbl. of 53°-gravity oil per day.

Operators, however, plan to complete the well in the shallower Rodessa pay, perforated at 10,773-80 ft.

Rodessa Field Indicated In Wayne County Discovery

Another Lower Cretaceous field appears to have been uncovered by a discovery by Larco Drilling Co. and Durbin Bond & Co. in northern Wayne County.

Their indicated discovery well, 1 Gray Estate, in 7-9n-6w, got good oil recoveries in two drill-stem tests in the Rodessa-Sligo section.

The first test, at 9,415½-21 ft., had 300 ft. of clean oil with 80 ft. of mud and the 3,000-ft. water cushion. It was made through ¼-in. chokes with tool open 20 minutes. Bottom-hole pressures were 1,495 psi., flowing, and 4,070 psi., shut in.

INDICATED Lower Cretaceous field discovered by Larco Drilling Co. and Durbin Bond & Co. in northern Wayne County. Chaparral, shown north of it, is only other Lower Cretaceous field in area.

The second test, taking in 8 ft. at 9,562-70 ft., recovered 1,650 ft. of clean oil and 50 ft. of oil-cut mud after being open only 10 minutes. Bottom-hole pressures were 2,405 psi., flowing, and 4.095 psi, shut in. Gravity of the oil was 39°.

The discovery is the fourth in Lower Cretaceous sands this year. It is 3 miles south of Chaparral (Hiwannee), a Lower Cretaceous field opened in 1952 by Gulf Refining Co. Other nearby fields produce from Eutaw and/or Tuscaloosa (Upper Cretaceous) sands.

The area is 6 miles north of Waynesboro.

NEW MEXICO

SAN JUAN BASIN

El Paso Gallup Outpost Well Flows Oil

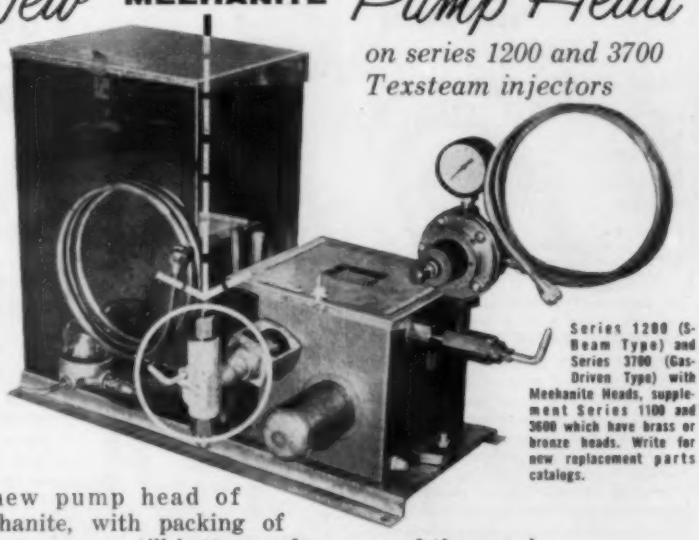
A wildcat 2 miles southeast of Carson field in San Juan County flowed 27½ bbl. of oil hourly through tubing from the Gallup sand. The well is El Paso 1 Brookhaven-A, NE SW SW 29-25n-10w. The well is shut in.

El Paso's long extension to the Carson area is 2 miles northwest of a new Gallup pool in C NW NE 4-24n-10w, opened by Moore, Moore & Miller at

LOOKING FOR A WAY TO CUT COSTS ON PRODUCTION PUMPING? SEE PAGE 25

New **MEEHANITE** *Pump Head*

on series 1200 and 3700 Texsteam injectors



Series 1200 (S-Beam Type) and Series 3700 (Gas-Driven Type) with Meehanite Heads, supplement Series 1100 and 3600 which have brass or bronze heads. Write for new replacement parts catalogs.

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So successful is this combination that several automatic pumping leases are now equipped with J-F Stuffing Boxes. The pumper visits these wells at 2 to 3-week intervals. Specific details on these operations available on request.

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1 Scott. That well flowed 192 bbl. per day from the Gallup.

• McRae Oil & Gas Corp. has completed 1 Kutz, wildcat operation in San Juan County as a commercial gas discovery from 162 ft. of pay in the Dakota sand.

On the latest production test, the well flowed gas at the rate of 12,000,000 cu. ft. per day. Representatives of the concern expect that when the hole is completely cleaned of fracturing residue the gas flow will increase to between 15,000,000 and 20,000,000 cu. ft. of gas per day. The well also is making an ungaged amount of condensate.

The production is from perforated intervals at 6,510-92 ft.; 6,608-20 ft.; 6,622-28 ft. and 6,666-72 ft. Those zones had been fractured with a total of 45,000 gal. of oil and 45,000 lb. of sand.

The discovery is on the northeast side of a block of 5,400 acres of leases McRae owns in northeast San Juan County. It is 8 miles southeast of Bloomfield and in C NE¼ NE¼ 28-28n-10w.

The company expects to soon begin an active program of development on the block. The 1 Kutz also has shown as a possible commercial gas discovery from the Cliff House section at 3,615-3,700 ft. and from the Graneros at 6,410-50 ft. Those zones now are cased off and will be produced at this time.

SOUTHEAST NEW MEXICO

Third Pay Indicated in Gas Field Exploration

Tidewater Oil Co. 6-C Coates-Federal, 24-25s-36e, Lea County, had oil from a third pay section, the McKee sand, while testing at 7,176-7,733 ft. The McKee test had gas in 5 minutes and oil in 45 minutes. It flowed to pits for 15 minutes at the estimated rate of 25 to 30 bbl. an hour. Operators re-

Tidewater's wildcat is on the eastern edge of Justice-Paddock gas field in southeastern Lea County.

National Torque Converters like this are setting new service records in the oil field and helping drillers to get maximum service from drilling rigs.

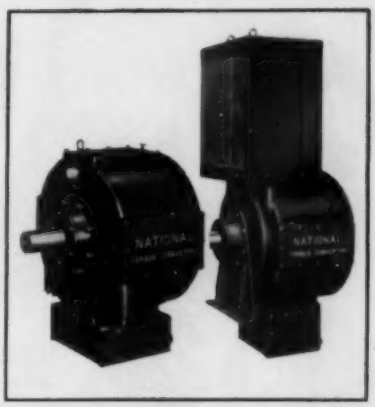
Another savings story...

Three National Torque Converters set a 27,500-hour continuous-operation record

In October 1953, three National Torque Converters were installed on an oil drilling rig operating near Odessa, Texas. During the next 39 months, the rig drilled 188,448 feet in 15 wells with no stoppages whatever for converter servicing. Since the rig was then without location, engines were overhauled, and converters checked. The only sign of wear was in one stator mount and bearing. These were replaced. Otherwise, the converters were ready for another record-breaking run.

The saving to the operator can be judged from the fact that converters formerly used had demanded repair every 15 to 18 months. Down-time was greater and cost of repairs more than double.

Constantly increasing costs make it imperative to make more hole with every rig every day, and National Torque Converters are helping operators throughout the producing fields to make it. They are available for in-



National Torque Converters are manufactured with or without integral cooling systems.

stallation on rigs in service, or as original equipment on rigs manufactured by the following companies: Bethlehem, Brewster, Cardwell, Continental-Emsco, Ideco, Joy, National, "Oilwell," Wilson and Unit Rig.

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versed out a full string of 41° oil, then cored ahead.

Prior tests recovered oil-cut mud and some free oil in the Clear Fork at 6,787-6,837 ft., and had flowing oil in the Tubb section at 5,920-6,000 ft.

Shell Oil Co. 1 Kimberlin, 22-19s-35e, has been completed as a San Andres discovery on the north side of Pearl field, Lea County. Potential was 116 bbl. of 32° oil, cut 5 per cent with water. Hole was drilled to 5,483 ft., total depth, then plugged back and perforated at intervals between 4,659-4,822 ft.

OKLAHOMA

NORTHWEST OKLAHOMA

Champlin Completes New Woodward County Discovery

Woodward County has its second producing area as a result of Champlin Oil & Refining Co.'s completion at 1 McDonald near the city of Woodward, C SE NW 1-22n-21w. This important confirmation to the county's potentialities as an oil and gas producer flowed 9,100 M.c.f. of gas per day with 365 bbl. of distillate per million, estimated, from perforations at 8,256-61 and 8,277-89 ft. in the lower Morrow sand.

Location was also announced for another wildcat try to the northwest at 1 Githens in C SW NE 33-23n-21w. It is thought that the Morrow reservoir that was opened last year at Union Oil Co. of California's Southeast Woodward field may cover 20,000 acres in this area of northwestern Oklahoma.

Northeast Gate Lake Field Adds Another Well

Keating Drilling Co. 1 Allen in NW NW SE 14-28n-26w, Northeast Gate Lake pool in Harper County, flowed 1,302 M.c.f. of gas per day on tests at 6,310-35 ft. in the Hoover sand.

SOUTHWEST OKLAHOMA

Deep Extension to Knox Deep Flows Gas-Distillate

British-American Oil Producing Co. moved deep Knox field production in Grady County 3 miles southeast into Stephens County at 1 Kreiger in C SW SW 3-2n-5w. The well flowed 7,000 M.c.f. of gas per day and 22½ bbl. of distillate per hour on tests of the second Bromide - Ordovician sand at 14,807-14,918 ft.

B.A. also has Viola lime production indicated at 13,850-13,965 ft., getting 1,430 M.c.f. per day.

Susie Confirmed By Sinclair Well

Sinclair Oil & Gas Co. et al have confirmed Northwest Alden field in Caddo County by completing 1 George Dyer, NE SW 1-6n-13w, as a first Bromide producer.

The well swabbed 179 bbl. of 36°-gravity oil in 24 hours through 2½-in. tubing from perforations in the first Bromide at 8,740-57 ft., 8,766-99 ft., and 8,808-38 ft.

The confirmation test is a west offset to the discovery well, the 1 Susie, C NW SE 1-6n-13w, which flowed 711 bbl. of 37.5°-gravity oil daily through an 18/64-in. choke from first Bromide.

Sinclair, the operator, owns 44.33 per cent of the 638-acre unit on which the pool is located; Cities Service Production Co. owns 50.66 per cent; Oklahoma Natural Gas Co. 3.13 per cent, and Pan American Petroleum Corp. 1.88 per cent.

ROCKY MOUNTAIN

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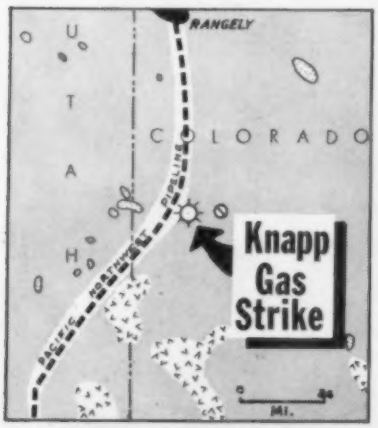
Aneth and East Aneth fields in the Paradox basin flowed 304 bbl. of oil per day on latest tests of perforations at 5,930-52 ft. in the Pennsylvanian.

The only top reported is the Molas at 7,284 ft. which is in the bottom of the Pennsylvanian.

COLORADO



A MORRISON-JURASSIC SALT WASH gas discovery well was completed by Knapp Uranium Development Co. at 1 Federal in SE SW SW 1-2n-3w, Mesa County, western Colorado. The well flowed 2,500 M.c.f. per day from open hole at 2,385-95 ft. Location is 5 miles southeast of Highline Canal Unit, a Dakota gas area. The Asbury Creek Unit Dakota gas area is 8 miles east. The new field is 4 miles west of the Western Slope Pipeline and 8 miles southeast of the Pacific Northwest Pipeline. A second well will be staked.

TEXAS

SOUTHWEST TEXAS

Oil Discovery Completed In Northern Jim Wells

Thomas Drilling Co.'s new oil-discovery well in northern Jim Wells County is rated good for 140 bbl. per day, gaged through P-33 choke. Flowing pressure is 880 psi. with gas-oil ratio of 1,080 cu. ft. per barrel. Gravity of the oil is 44°. Production is from perforated interval at 5,175-83 ft. in hole drilled to 6,079 ft.

The well, 1 D. Stehle, is in Section 3, H&GN Survey, about 20 miles north of Alice.

TEXAS PANHANDLE

Hansford County Gets Woodson Oil Discovery

A Woodson (below the Atoka-Penn.) discovery was reported in Hansford County. The discovery well is Shamrock Oil & Gas Corp. 1 C. B. Barber et ux, 9 miles northeast of Spearman and 1¼ miles northeast of East Spearman-Atoka sand field.

The well was completed on pump for 133 bbl. of oil per day, 35° gravity. Perforations are at 6,988-7,016 ft. Top of the Atoka is 6,952 ft.; Woodson, 6,998 ft. The well is Section 8, Block 2, WCRR Survey.

WEST TEXAS

Deep Andrews Prospector Will Make Permian Discovery

Continental Oil Co.'s 1 Teague, scheduled 13,400-ft. wildcat southeast of Andrews, has been assured of discovery production from the Wolfcamp.

On drill-stem test at 8,776-8,806 ft., gas surfaced in 4 minutes and fluid in 20 minutes. After flowing into pits for 20 minutes, the well gaged 115 bbl. of oil in 2 hours through 1-in. choke.

No. 1 Teague is in Section 1, Block A-44, PSL Survey, 3 miles southeast of Andrews and about half way between Wolfcamp production in South Means and Wemac fields.

Elsewhere in Andrews County, a deep wildcat was backing up to try for a Wolfcamp discovery. Champlin Refining Co. 1 University "L," 3 miles northwest of South Andrews field, plugged back to 8,606 ft. from total depth of 12,688 ft.

Twenty-two hours of swabbing on Wolfcamp perforations at 8,424-8,584 ft. developed 60 bbl. of 32° new oil,

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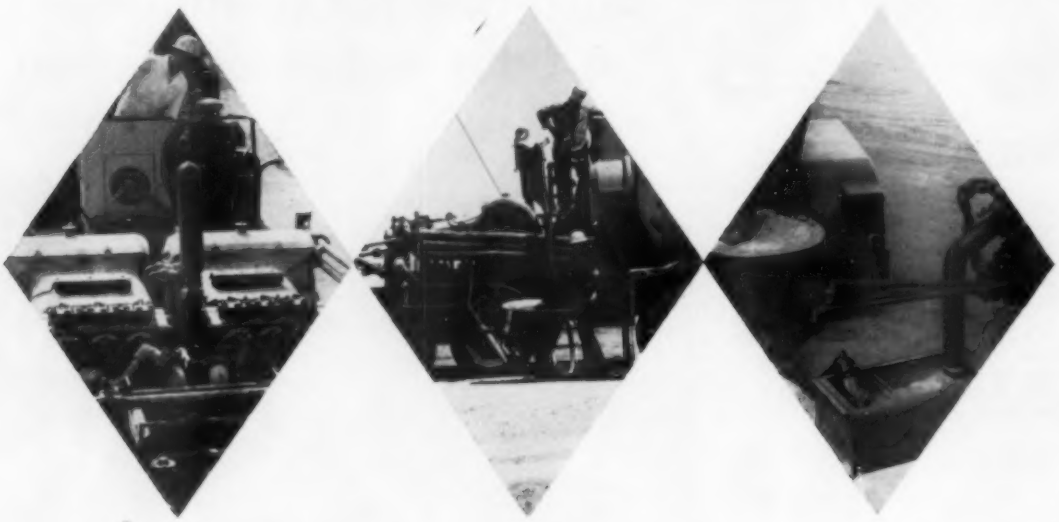

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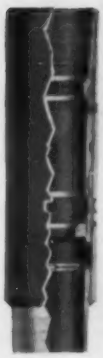

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HALLIBURTON CEMENT BASKETS...often used below "DV" Multiple Stage Cementer to retain cement and protect weak formations by reducing slurry loss of formation breakdown. Run on outside of casing or liner at point above weak or porous formations. After cement is pumped, basket opens, helps support heavy cement columns until they take initial set.

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18 bbl. of load oil and approximately 100 bbl. of acid residue and sulfur water.

On ground elevation of 3,179 ft., formation tops in Champlin's test were Devonian 10,750 ft., Montoya 11,976 ft., and Ellenburger at 12,652 ft.

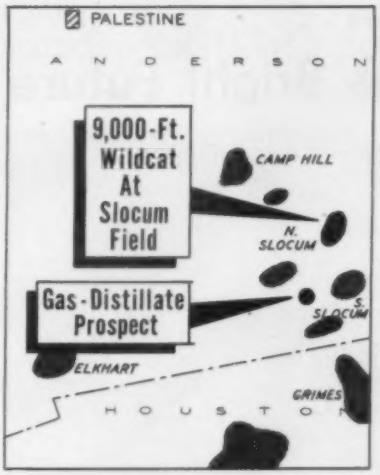
EAST TEXAS

Slocum Fields Draw Deep Test And Gas-Condensate Prospect

Anderson County was back in the news again last week with further interesting developments in the Slocum (Woodbine and sub-Clarksville) areas in the southeastern corner of the county.

Distillate prospect . . . Texkan Oil Co. of Dallas 1 G. B. Wallace, nearly 1 mile west of Woodbine production in South Slocum field, reported a number of successful drill-stem tests. Cores and electrical surveys indicated 8 ft. of pay sand in the Woodbine at 5,868-78 ft. Initial drill-stem test flowed gas and condensate, with volume not estimated. Flowing pressure was 240 psi., using ¼-in. top and bottom chokes. Recovery was 90 ft. of 60° condensate.

Another test, at 5,874-78 ft., using the same chokes and open 30 minutes, had gas in 5 minutes, estimated at 2,500 M.c.f. a day. Gas-liquid ratio was estimated at 30 bbl. per 1,000 M.c.f. Surface flowing pressure reached 1,520 psi., with bottom-hole pressure ranging from 1,905-2,015 psi.



Map shows location of the proposed deep test, and a gas-distillate discovery in the Slocum area of southeastern Anderson County.

Location of 1 Wallace is in the E. Austin Survey, A-88. It was drilled on a farmout from General American Oil Co. of Texas and Atlantic Refining Co., with acreage contributions from Signal Oil & Gas Co. and Concho Petroleum Co.

Harrison County . . . A second producer has been completed in Northeast Hallsville field, 6 miles northwest of Marshall. The well is Amerada Petroleum Corp. and Trice Production Co. 1 E. C. McBrayer, located ¾-mile southwest of the discovery, in the S. Choat Survey.

Initial potential, from the Crane section of the Pettet limestone at 6,943-55 ft., was 342 bbl. of 54.7° oil a day through ¼-in. choke. Flowing pressure was 900 psi. on tubing. Gas-oil ratio was 1,281:1.

Amerada's 1 John White opened the area, flowing 340 bbl. of oil a day from pay at 6,957-66 ft.

Deep wildcat staked . . . Location for a 9,000-ft. exploration has been staked in the Slocum townsite portion of North Slocum field. The test will be drilled by John G. Nichols as 1 L. H. Greenwood. According to reports, location is on a 5-acre tract in the W. R. Wilson Survey, Abstract 66. The 9,000-ft. depth should give the operators a look at the Travis Peak.

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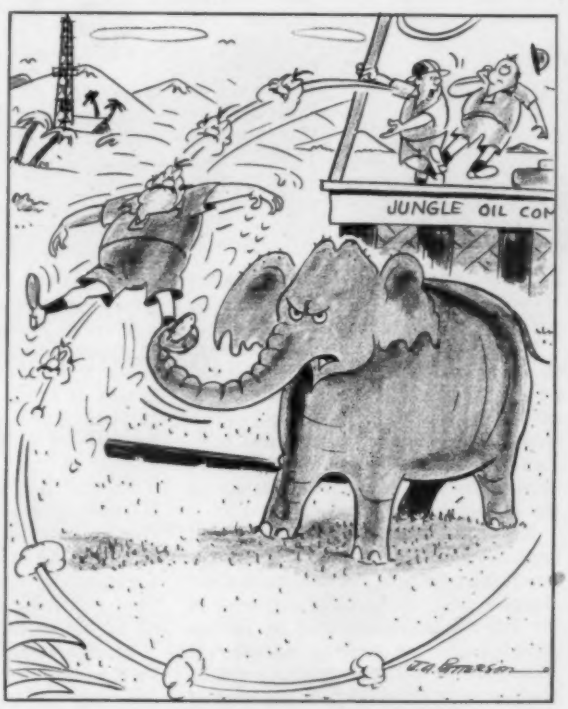


"Westgate's really gonna' know he's been places tomorrow."

He's hard on crepe hangers . . .

. . . Houchin Sees Bright Future

THE crepe hangers in the oil industry need to chat with John M. Houchin.

This 48-year-old new vice president for Phillips Petroleum Co. has no room in his makeup for those who spread fear the oil business has had its heyday and is on the road down.

The industry got its first good look at Houchin last year before he was promoted to Phillips' top-level executive team. The energetic Oklahoman appeared before a national gathering of security analysts in Boston. With characteristic warmth and conviction, Houchin did a double job:

He recounted the amazing feats the oil industry has achieved over the last 50 years to meet the big upsurge in energy requirements. Then he took in after those who claim the U. S. is running out of oil. He ticked off a list of fabulous potential reserves the industry could develop — if given the economic climate it deserves.

Houchin was qualified by experience and insight into industry problems to speak his words of faith and warning to the investment men. His company recognized this a few months later. Last January Phillips elected Houchin a vice president. In his new job, Houchin has duties relating generally to over-all company activities. But his primary responsibilities are with the production and foreign departments.

Scope of the foreign department was expanded when Houchin took over. The department now handles all activities in negotiating, exploring for, and acquiring raw materials in foreign countries. Producing operations in Canada and Alaska were retained in the production department.

Emphasis on production . . . Houchin started work with Phillips before he got out of college.

He joined the production department in Oklahoma City in 1933 while still an engineering student at the University of Oklahoma. He received his petroleum engineering degree the next year. And for several years he did many engineering jobs in various areas of the production department.

Houchin later served as assistant superintendent in two of the company's producing districts, as assistant chief engineer and acting chief engineer in the Bartlesville office, and as district superintendent in western Kansas. He moved up to assistant general superintendent of the production department in 1944 and became general superintendent in 1951.

JOHN M. HOUCHIN
. . . promoted to first team

Houchin's big step up came in February 1956 when he was advanced to chairman of Phillips' operating committee. This committee includes about a dozen departmental management people. It reviews policy and operating and expansion proposals coming from all parts of the company. It is also a great training ground for future Phillips executives. Houchin moved from the operating committee post to his present job.

What's ahead . . . Houchin is seriously aware of the challenges in his new job.

The company's big production tasks ahead lie in secondary recovery, automation, and foreign operations.

Phillips has long been a leader in secondary recovery. Houchin says the company will devote much future energy to initiating and perfecting methods to produce every possible drop of economically recoverable oil. He thinks that with development and perfection of techniques now under study ultimate recoveries may be boosted as high as 80 to 90 per cent of total original oil.

Phillips also is stepping up its use of automation in oil production. On a Phillips lease in the Texas Panhandle, the first installation of its kind now automatically controls every operation from producing the wells to delivering oil to the pipeline.

Foreign operations are not new to Phillips. For more than 10 years the company has been an important producer in Venezuela. It will expand its activities in that country by developing concessions it won recently with several other companies. Phillips has huge acreage holdings in Canada that are promising. It has nice production in the Kuwait-Saudi Arabian Neutral Zone through a big interest in American Independent Oil Co. It is exploring a big Alaskan concession—so far with little success.

Through this search for additional foreign production, Phillips expects to attain a better raw-materials flexibility in the years ahead.

Houchin's faith in the future of the oil industry is summed up briefly in these words:

"Of this I am certain: The oil industry's capabilities in energy production are unequalled by any other. And regardless of the source or nature of this country's future energy supplies, our industry will be in the forefront of their production."

Robert B. Capps, staff geologist for Kerr-McGee Oil Industries, Inc., in Oklahoma City, has been promoted to southern division exploration manager in New Orleans.

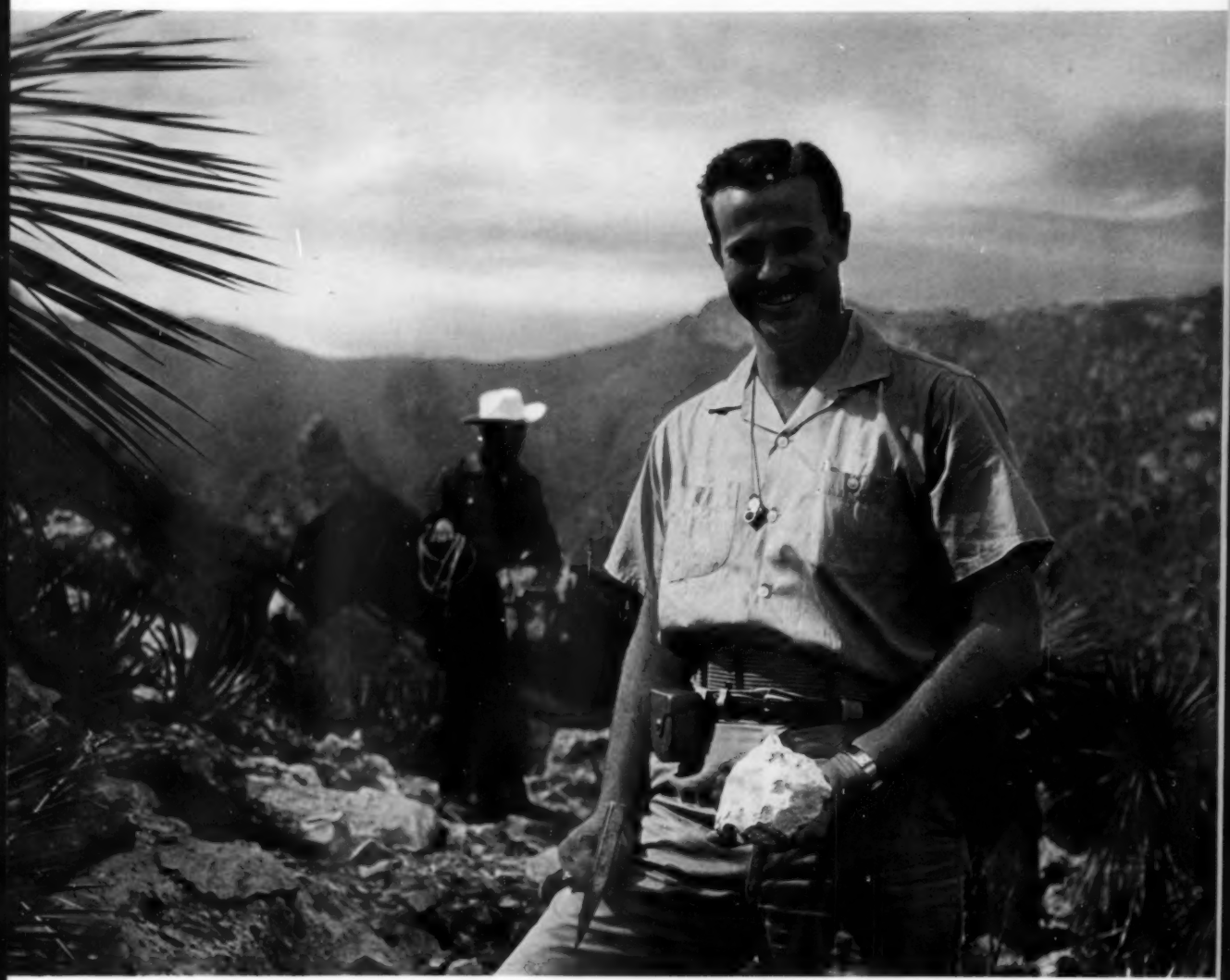
Donald E. Radtke, Magnolia Petroleum Co. district petroleum engineer in Pampa, Tex., has joined M. E. Daniel in Breckenridge, Tex., as general superintendent.

I. C. BROWN

Irving C. Brown, superintendent of the Richmond, Calif., refinery of Standard Oil Co. California, Western Operations, Inc., has been appointed manager of the company's Bakersfield, Calif., refinery. He succeeds **L. L. Henning,** who has been transferred to San Francisco on special assignment. A graduate of the University of Michigan, Brown has been with Standard of California since 1938. He was assistant superintendent of the Richmond refinery before being named superintendent in 1955.

R. R. McCarty has been promoted by Humble Oil & Refining Co. from assistant superintendent of its southwest production division at Corpus Christi, Tex., to superintendent of the western production division at Midland, Tex. He replaces **J. W. House,** who recently resigned to become an independent at Midland. Filling the position temporarily had been **L. H. Byrd,** assistant division superintendent.

It takes a complete team to keep dependable drilling mud available for you



Meet this Magcobar Man, the geologist . . . he explores the world—and "moves mountains" to bring you drilling muds

The Magcobar Geologist works in all of the 48 states and many foreign countries—always on the look-out for useable mineral deposits.

What he finds determines whether or not there will be adequate mineral reserves available in years to come for safe, economical drilling muds.

What would happen if you couldn't properly "mud-up" your next drilling location? The Magcobar Geologist's job is to keep that from happening.

Magcobar Geologists are men you probably never will see—but if they were not on the job every day—all over the world—your future drilling operations might be greatly handicapped.

The Geologist is a vital part of the Magcobar team—the team that brings you the most complete mud service everywhere.

MAGNET COVE BARIUM CORPORATION

Houston, Texas

Magcobar
Complete
DRILLING MUD SERVICE

Drivers get set to "hit the road" with the first of the 1000 new Power Giants ordered by Ryder System, Inc.

Dodge awarded 1000-truck order

"We picked these Dodge Power Giants to give our truck-lease customers the finest hauling and delivery operation at lowest cost", James Ryder (right), president of Ryder System, Inc., tells Lee F. Desmond, vice president of Dodge.

Ryder System, Inc., world's largest exclusive truck-leasing company, puts low-cost operation first... picks Dodge for record order

When your business is leasing trucks, there's only one way to make it pay off. And that's by keeping your operating costs per mile at rock-bottom levels. That's why Jim Ryder, president of Ryder System, Inc., decided on Dodge when he needed new trucks. He knew that Dodge trucks are built to take extra miles without extra costs.

For instance, new Dodge *Power Giant* V-8's are the most powerful of the low-priced three. And that extra power lets you handle the ruggedest hauling jobs with less engine strain. Less strain means less wear and, of course, fewer repairs. Exclusive Power-Dome design delivers premium performance on regular gas, too. "I save money both ways", says Jim Ryder. "But more important, I know that my customers will be thoroughly satisfied with any Dodge *Power Giant* they lease."

Why not do as Jim Ryder did . . . check into the facts with your Dodge dealer. You'll find a Dodge *Power Giant* will pay off for you, whatever your business.

DODGE

Power Giants

Most Power of the Low-Priced 3

Personals

Rex H. Beal has been promoted by Warren - Bradshaw Exploration Co. to district drilling superintendent and transferred from Madill, Okla., to West Texas - New Mexico district headquarters in Midland, Tex. Beal was tool pusher for the company's Southern Oklahoma-North Texas district at Madill. He has been with the company since 1948.

S. G. Creaghe, design engineer at Phillips Pacific Chemical Co.'s Kennewick, Wash., plant, has joined the American Petroleum Institute's Division of Production in Dallas as staff engineer.

Albert Meilus has joined Warren Refining & Chemical Co., Cleveland, as chief chemist in the lubrication division. Meilus was formerly with Southwest Grease & Oil Co. in Wichita and before that with British American Oil Co., Ltd.

Frank R. Markley, vice president and a director of Sun Oil Co., has been given executive responsibility for transportation activities of the company. Markley has been Sun vice president in charge of marketing since 1950, and a director since 1946. He joined Sun in 1920.

Dr. Kenneth Merle Watson, formerly vice president of Pure Oil Co., has joined the chemical-engineering department of Illinois Institute of Technology. Watson was director of research for Pure before becoming vice president in 1954. He was engineering coordinator for Gulf Oil Corp. and director of engineering research for Universal Oil Products Co. at one time.

Richard D. Allen, Lloyd Aubert, James M. Burns, Billy J. Langford, and **Burleigh W. Shepard** have been transferred by Shell Oil Co. from Salt Lake City to the new Farmington, N. M., production division as development engineers. **William C. Miller, Robert W. Olson,** and **Arthur O. Spaulding,** development engineers from Los Angeles, have also been transferred to Farmington. Others moved to the new office include **James R. Dozier,** mechanical engineer from Bakersfield; **Gerald E. Godard** and **Karl Hauptfleisch,** engineering assistants from Salt Lake City; **Larry C. Kempton,** mechanical engineer in Salt Lake City; **Vaughn E. Malquist,** production foreman in Oilfields, Calif., and **Leon C. Michaelson,** mechanical engineer, Long Beach.

Byron V. Cox, Jr., has been named district engineer for Republic Natural Gas Co. and transferred to Hugoton, Kans., from Pauls Valley, Okla.

Dewey K. Davis, formerly drilling superintendent for Penrod Drilling Co. in Shreveport, La., has been named vice president and general superintendent of Prince Marine Drilling & Exploration Co. in Houston.

C. J. Harrison has been transferred to Lone Star Producing Co.'s new Shreveport, La., office as district exploration manager. Harrison was formerly in Jacksboro, Tex.

Charles A. O'Neal has been transferred by Sinclair Oil & Gas Co. from Healdton, Okla., to Velma, Okla., as district foreman. **Doyle F. Cheatwood,** assistant district foreman at Lindsay, Okla., has been transferred to Yale, Okla.

Gilbert H. La Piere, formerly petroleum engineer with Chase Manhattan Bank, has joined the New York Stock Exchange as manager of the oil and gas department. La Piere was with Cities Service Oil Co. before joining Chase Manhattan.

G. L. Parkhurst, vice president of Standard Oil Co. of California, has been named chairman and chief executive officer of California Chemical Co., new Socal subsidiary. **P. L. Fahrney,** also a Socal vice president, has been named California Chemical president.

H. A. Logan, Jr., executive vice president of United Refining Co., Warren, Pa., has been elected president. He succeeds his father, the late Harry A. Logan, Sr. **Fred G. Bannerot, Jr.,** vice president of the company and president of Elk Refining Co., has been elected chairman of the board and **John P. Wendell,** a director, has been named executive vice president and secretary.

J. M. Clevenger, Sinclair Oil & Gas Co.'s district production superintendent in Big Spring, Tex., has been promoted to assistant offshore division superintendent and transferred to New Orleans. **Robert A. Bonnell, Jr.,** assistant district superintendent at Odessa, Tex., will succeed Clevenger at district-production superintendent in Big Spring. **Cuyler G. Conger** has been transferred to Odessa to replace Bonnell. Conger was formerly intermediate petroleum engineer at Hobbs, N. M. Clevenger joined Sinclair in 1926. Bonnell has been with the company since 1939, Confer since 1951.

P. L. Smith has been promoted by Magnolia Petroleum Co. from manager of operations of the company's Beaumont, Tex., refinery to general manager of the refining division at Beaumont. **F. M. Graves,** formerly executive assistant, has been moved up to assistant general manager of the division. **R. C. Adam** was promoted from manager of technical services to manager of operations, and **W. M. Bradshaw,** formerly aide to the executive

P. L. SMITH

F. M. GRAVES

assistant, has moved up to executive assistant. Smith, as general manager of the division, will administer all phases of operations at the refinery as well as

R. C. ADAM

W. M. BRADSHAW

terminal and product-movements operations at Magpetco in Jefferson County, Texas, and in the Corpus Christi-San Antonio area. Smith headed the plant's technical department for 17 years before being named operations manager in January 1956.

Cameron L. Cox, Sinclair Oil & Gas Co.'s assistant district superintendent at Nowata, Okla., has been named district superintendent in Jackson, Miss. **George V. Dunn, Jr.,** senior petroleum engineer in Tulsa, has been transferred to Nowata to succeed Cox.

Thomas S. Nichols, president of Olin Mathieson Chemical Corp., has been elected chairman of the board. He succeeds **John M. Olin. Stanley Osborne,** executive vice president, will succeed Nichols as president. Nichols became president of Mathieson Chemical Corp. in 1943 and remained president of Olin Mathieson after the merger of Mathieson and Olin Industries, Inc., in 1954. Osborne joined Mathieson in 1950.

Personals

Vern Horte, petroleum engineer with DeGolyer & MacNaughton, has joined Trans-Canada Pipe Lines, Ltd., in Calgary as chief gas supply engineer. Horte is a graduate of the University of Alberta. He was with the Alberta Petroleum and Natural Gas Conservation Board before joining DeGolyer & MacNaughton in 1952.

John T. Murphy, Jr., has been promoted by Atlantic Refining Co. to district geophysicist in Lafayette, La. He was formerly party chief in Laredo, Tex.

Harold G. Moss has joined the Sugar Creek, Mo., research department of Standard Oil Co. (Ind.). Moss was formerly with Esso Research & Engineering Co.

Frank B. Fehsenfeld, Crystal Flash Petroleum Corp., Grand Rapids, Mich., has been elected president of the Michigan Petroleum Association. Other officers are **V. H. Kellerman,** Star Oil Co., vice president; **Ferris J. Rennie,** Rennie Oil Co., secretary; **George A. Begick,** Lansing Oil Co., treasurer; **Joseph D. Hadley,** executive secretary and general counsel.

Curtis M. Smith, Houston, vice president of Tennessee Gas Transmission Co., has been elected president of the Southern Gas Association, succeeding **R. A. Puryear, Jr.,** president of Alabama Gas Corp., Birmingham. Also elected officers were **Carl E. Cloud,** MidSouth Gas Co., first vice president; **O. W. Clark,** Southern Natural Gas Co., second vice president; and **R. L. Hinch,** Nashville Gas Co., secretary. **Kyle H. Turner,** Atlanta Gas Light Co., assistant secretary; and **Willard G. Weigel,** Lone Star Gas Co., treasurer, have been reelected. **James A. Davis,** Empire Southern Gas Co., has been named chairman of the association's advisory council, and **Cecil Webb,** Oklahoma Natural Gas Co., has been named council vice chairman. Seven men have been named to the association's board of directors. They are **Scott Hughes,** Southern Union Gas Co.; **George Guler,** Minneapolis - Honeywell Co.; **Hugh Steen,** El Paso Natural Gas Co.; **H. J. Friloux,** Norco Gas Co.; **T. S. Whitis,** Pioneer Natural Gas Co.; **A. L. Roberts,** Texas Gas Transmission Corp.; and **John Parrott,** Roanoke Gas Co.

Robert S. Ryan, petroleum engineer with Pan American Petroleum Corp., has been transferred to Tulsa from Cody, Wyo.

Fred W. Kelly, Jr., geologist with Ohio Oil Co. in Ardmore, Okla., has been assigned to Oasis Oil Co., Ohio Oil subsidiary, and transferred to Libya.

Zoltan Hegedus, formerly of the University of Budapest, and **Edward R. Michaelsen** have joined Atlantic Refining Co. as junior development engineers.

Vernon I. Hill, Jr., geologist with Cities Service Oil Co., has been transferred to Oklahoma City from Bartlesville, Okla. Hill, a graduate of the University of Colorado, joined Ciites Service in 1955.

C. J. Grant, general drilling superintendent for Mountain States Drilling Co., Inc., has been elected vice president of the company. Grant has been general drilling superintendent since 1949.

H. D. Spires has been transferred from Chickasha, Okla., to Oklahoma City as district superintendent of Tidewater Oil Co.'s new Oklahoma City district production office. **W. E. LaRoche,** area engineer at Hobbs, N. M., has been transferred to Oklahoma City as district engineer.

John W. Newton, who retired May 1 as vice president and general manager of the refining division of Magnolia Petroleum Co., has been elected president and general manager of Norvell-Wilder Supply Co. of Beaumont. Newton was already a director of Norvell-Wilder. As president he succeeds the late Frank S. Carothers. Newton had been with Magnolia for 43 years before his recent retirement. He is a past vice president of the American Petroleum Institute's Division of Refining.

John O. Holder, Service Pipe Line Co., Tulsa, has been elected president of Petroleum Industry Electrical Association. He succeeds **H. A. Rhodes,** Transcontinental Gas Pipe Line Corp., Houston, who has been named chairman of the board of the association. Other officers of the group are **E. H. Wilder,** Sun Oil Co., Beaumont, vice president; and **E. B. Dunn,** Atlantic Refining Co., Philadelphia, secretary-treasurer. New directors are **Tom B. Kelly,** Texas Eastern Transmission Corp., Shreveport; **A. E. DeMattei,** Southern Pacific Pipe Lines, Inc., San Francisco; and Dunn.

Gordon R. King has opened offices as a consulting engineer in Amarillo, Tex.

A. D. Wilbur, head of the proration department of Humble Pipe Line Co. since 1940, has retired.

A. A. Glueck, production foreman with Shell Oil Co. in Corpus Christi, Tex., has been transferred to Quitman, Tex., as construction and maintenance foreman.

Ronald H. Brown has been promoted by Shell Oil Co. from area engineer to chief inspection engineer and transferred to Wilmington, Calif., from Wood River, Ill.

C. J. Hansen, senior engineer in Pittsburgh with Gulf Oil Corp., has been transferred to Gulf's Staten Island, N. Y., refinery as director of engineering costs and plant economics.

George B. Magruder, Jr., Fort Worth division superintendent of gas contracts and measurement for Sinclair Oil & Gas Co., has resigned to become an independent oil operator and consultant at Fort Worth. Magruder was a vice president of Southern Production Co., Inc., before that firm was acquired by Sinclair. Before that he worked with Gulf Refining Co., Texas Pacific Coal & Oil Co., Marland Oil Co., and Danciger Oil & Refining Co. He was a vice president of Danciger when it merged with Southern Production in 1950.

Lysle R. Kirk of Ohio Fuel Gas Co., Columbus, Ohio, has been elected chairman of the eastern district of American Petroleum Institute's Division of Production. **Harry T. Heuple,** Manufacturers Light & Heat Co., Pittsburgh, is new secretary-treasurer, and **Douglas Rogers, Jr.,** South Penn Oil Co., Bradford, Pa., is chairman of the district advisory committee. Vice chairmen are **R. C. Curtis,** Carter Oil Co., Mattoon, Ill.; **L. T. Evans,** East Ohio Oil Co., North Canton, Ohio; **Millard Flood,** Ohio Oil Co., Terre Haute, Ind.; **J. Robert Hornor,** Delaware Gas Co., Clarksburg, W. Va.; **R. J. Murdy,** New York State Natural Gas Co., Pittsburgh; **H. J. Magner,** Delta Drilling Co., Pittsburgh; **Wendell Moore,** Columbian Carbon Co., Charleston, W. Va.; **Quentin Wood,** Quaker State Refining Co., Bradford, Pa.; and **Dean Russell,** Gordon Drilling Co., Mount Pleasant, Mich.

E. D. BROCKETT

E. D. Brockett, Jr., manager of Gulf Oil Corp.'s Houston production division and a vice president of the company, has been transferred to Pittsburgh as coordinator, production department. **S. G. Sanderson,** manager of the company's Tulsa production division, also a vice president, will succeed Brockett in Houston. **N. C. Simpson,** operations coordinator for the Western Hemisphere production department in Pittsburgh, has been transferred to Tulsa to succeed Sanderson. Brockett has been with Gulf since 1934. He has been Houston production manager and a vice president since 1955. Sanderson was elected a vice president earlier this year. He has been Tulsa division manager since 1956 and was manager of production for the Tulsa division before that time. Simpson was division-production manager in Houston before transferring to Pittsburgh in 1955.

S. G. SANDERSON

N. C. SIMPSON

David S. Stear has been transferred by The Texas Co. to New Iberia, La., from Golden Meadow, La., as petroleum engineer.

James A. Hall, assistant chief engineer with the Texas Railroad Commission in Austin, Tex., has joined the Cotton Valley Operators Committee in Cotton Valley, La., as reservoir engineer.

F. A. Heitmeyer, general superintendent of the northern division production department of Standard Oil Co. of California at Taft, Calif., has been named acting manager of the Taft division office. He replaces **W. A. Eardley,** who is on loan to Iranian Oil Participants, Ltd., in London. **C. L. Taylor,** district superintendent for the company at Kettleman Hills, Calif., succeeds Heitmeyer as general superintendent of the northern division production department. **C. W. Townsend** has been appointed acting district superintendent at Kettleman Hills, succeeding Taylor.

Walter H. Williams, Jr., has joined Tekoil Corp.'s engineering staff in Oklahoma City. Williams was formerly with Pan American Petroleum Corp.

R. C. Tuttle, Tulsa geological consultant, has joined Rupnik & Ballou, Tulsa, as geological and geophysical consultant. Tuttle was with Sinclair Oil & Gas Co. before becoming a consultant.

Gerald H. Thurston, chemical-engineering supervisor with the Pan American Petroleum Corp. in Tulsa, has been transferred to Amoco Chemicals Corp. in Chicago as manager of commercial development.

J. Ronald Getty has been appointed Tidewater Oil Co. administrative vice president for marketing with headquarters in San Francisco. He succeeds **P. E. Allan,** who has retired. Getty was recently elected a director of Tidewater and is a director of Tidewater Oil Co. (England), Ltd.

G. Flint Sawtelle, formerly with Kirby Oil & Gas Co., has been elected president of Toklan Oil Corp., affiliate of Kirby. Sawtelle succeeds **A. F. Childers,** who has resigned. Headquarters of Toklan, moved to Houston from Tulsa earlier this year, have been moved back to Tulsa.

Jack Trout, head of the crude-evaluation group in Esso Standard Oil Co.'s Bayway refinery technical-service department, Linden, N. J., has been transferred to the company's Bayonne, N. J., refinery as a supervisor in the fuel-terminaling division. Trout succeeds **Gordon Seeler,** recently named head of the fuel-terminaling division at Bayonne. **Ross Quincey** replaces Trout as head of the crude-evaluation group at Bayway in addition to his position as head of the chemical-products group there.

R. C. Granberry, assistant chief petroleum engineer in Humble Oil & Refining Co.'s Houston petroleum-engineering division, has been named assistant superintendent of the southwest Texas division in Corpus Christi. **John G. Calvert,** East Texas division petroleum engineer, has been appointed assistant East Texas division superintendent succeeding **O. L. Furse,** who was recently named superintendent of the eastern division at New Orleans. **H. H. Meridith, Jr.,** has been named to replace Calvert as East Texas division petroleum engineer. **R. L. Pinion, Jr.,** has been transferred to Corpus Christi from Houston as division civil engineer.

Personals

Robert S. Neel, geologist in Shell Oil Co.'s Casper, Wyo., division, has been transferred to Denver.

O. W. Ward, division production superintendent at Fort Worth for Tennessee Gas Transmission Co., has been named vice president of the Canadian division's production department and transferred to Calgary. Before joining T.G.T., Ward was vice president of Johnston Testers, Inc., and before that was production manager in Los Angeles for British-American Oil Producing Co. He joined T.G.T. in 1952 as West Texas district production superintendent and became division superintendent in 1954.

DEATHS

Addison Browne Dally, who was associated for more than 50 years with the Michael L. Benedum oil interests, died last week at his home in Crafton, Pa., near Pittsburgh. He was 95. Dally entered the oil business in the 1880's after graduating from Western University of Pennsylvania, now the University of Pittsburgh. At one time he was manager of Manufacturers Light & Heat Co. and helped Benedum and the late Joseph Trees organize Arkansas Natural Gas Co. At his death, Dally was chairman of Hiawatha Gas & Oil Co. and Penn Ohio Oil Co. and a director of Plymouth Oil Co.

Georges P. F. Jouine, 72, head of Gladys City Oil, Gas & Manufacturing Co., died May 7 in Houston. A native of France, Jouine was first French consular agent in Houston from 1924 until 1941. He later became an American citizen and headed the oil company until 1955.

Sam C. Kiser, 75, retired production foreman with Gulf Oil Corp., died May 2 in Tulsa.

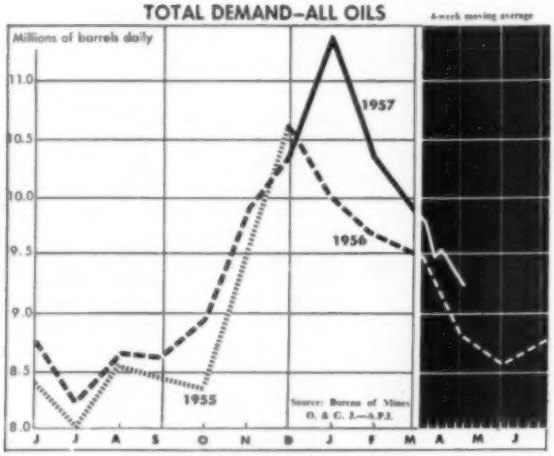
Thomas J. Moran, Sr., 87, retired Oil City, Pa., oil producer, died April 30 in Oil City.

Robert Edward Murphy, 56, marine engineer in Houston with Sinclair Oil & Gas Co., died May 1 in Galveston, Tex.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,522,575	DOWN	18,900	UP	421,635
Crude stocks	259,685,000	UP	2,604,000	DOWN	13,837,000
Completions	916	DOWN	60	DOWN	156
Refinery runs	7,633,000	DOWN	1,000	DOWN	31,000
Gasoline stocks	198,332,000	DOWN	1,890,000	UP	9,112,000
Kerosine stocks	21,165,000	UP	1,002,000	UP	2,816,000
Distillate stocks	79,119,000	UP	4,221,000	UP	15,129,000
Residual stocks	37,571,000	UP	771,000	UP	4,355,000
Four-product stocks	336,187,000	UP	4,104,000	UP	31,412,000
Total imports	1,520,700	UP	58,900	UP	193,500



Gulf Coast Product Market Weakens, Gasoline and Distillate Prices Drop

CONTINUING pressure on light-heating-oil prices on the Gulf Coast has gained some recognition in the form of cuts in formal quotations. Reported quotations for No. 2 fuel in cargo lots dropped 0.25 cent to 10.00 cents a gallon. Kerosine is off by the same amount to 10.50 cents.

Reports from the area indicate that material has been available at these prices for at least a month and a half, and that both kerosine and distillate fuel can be purchased at 0.25 cent off current formal postings. This means that No. 2 fuel is available at 9.75 cents a gallon on the cargo market and kerosine at 10.25 cents.

At this time last year, the low for No. 2 fuel on the Gulf Coast was 8.75 a gallon or 1 cent below the current market. Kerosine last year was selling for 9.5 cents compared with 10.25 cents now.

Residual fuel on the Gulf Coast still is carrying a price of $2.75 a barrel but the market is reported to be listless. The price is good compared with last year when the quotation was $2.10 a barrel.

The over-all picture on the Gulf Coast is this: Light fuels are selling about a cent a gallon above prices at this time last year, and heavy fuel is up about 1.5 cents a gallon. On the other hand, gasoline is selling for less than it did last year, and the price of crude is up a full 25 cents a barrel.

The condition of the gasoline market is shown by recent bids on gasoline for the federal Government. The bids were reported to have ranged as low as 10.00 cents a gallon for 90-octane regular gasoline. The average was close to 10.50 cents. Formal cargo quotations for 90-octane are now reported at 11.25 cents a gallon, off 0.25 cent with other cuts on the way. Plenty of material is actually available at 10.75 cents.

At this time last year, 90-octane gasoline was selling for about 11.25 cents a gallon on the Gulf Coast or about half a cent a gallon more than current spot prices.

To get an idea of how refiners' income on the Gulf Coast checks against last year, the plus and minus products can be balanced out against the volume of each product from a barrel of crude.

The area produces about 18.5 gal. of gasoline from a barrel of crude. The price drop from last year of half a cent a gallon would result in a loss of 9.3 cents on the gasoline from a barrel of crude.

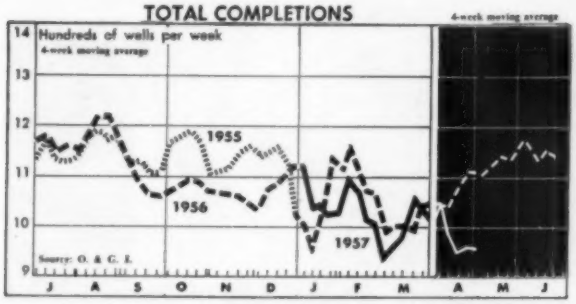
Distillate plus kerosine accounts for about 12.2 gal. of the crude barrel. An increase of about a cent a gallon means a gain of 12.2 cents. Since about 5 gal. of resid is made from a barrel of crude, a net gain of 1.5 cents a gallon puts another 7.5 cents on the plus side.

The combination of plus 12.2 cents and 7.5 cents with a loss of 9.3 cents represents a net gain of 10.4 cents on these major products from a barrel of crude.

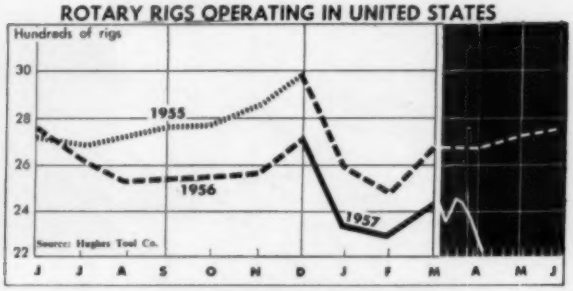
But, crude is up 25 cents a barrel. This means that for the Gulf Coast refiner to break even with last year, he must make up the extra 14.6 cents due on crude and cover all increases in processing costs out of extra returns from the minor products such as lubes, wax, asphalt, and others. Prices on these products are not up enough to make up the loss.

Grade 26-70 natural gasoline on the North Texas market settled to 3.5 cents a gallon on May 2. Group 3 had a split price of 4.0-4.5 cents through May 3, but quotations dropped to 4.0 cents by May 6.

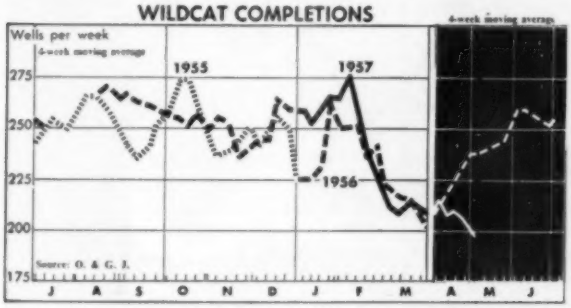
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	5-6-57	4-29-57	5-7-56
North Central and East	110	85	121
Southeast	42	47	29
Okla., Kans., Ark., Mo.	371	414	484
Louisiana	411	420	443
North and East Texas-Panhandle	258	378	440
Gulf and South Texas	201	192	255
West Texas-New Mexico	516	514	546
Rocky Mountain	228	231	241
Pacific Coast	96	91	130
Total United States	2,233	2,372	2,689
Canada	122	103	137

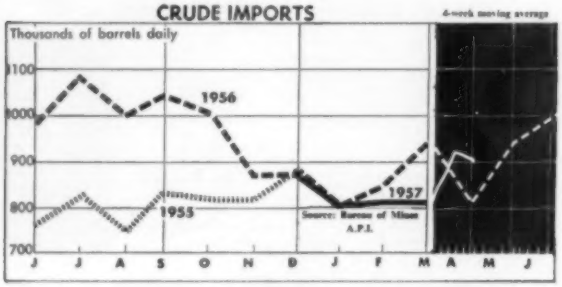
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MAY 4, 1957

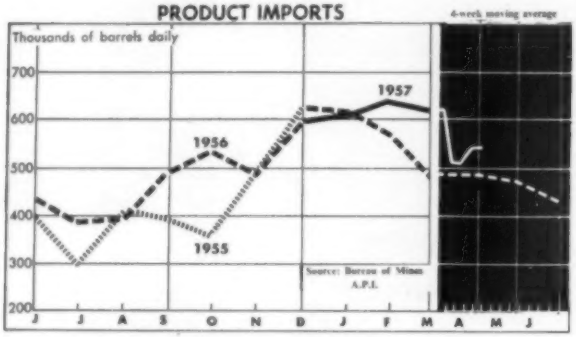
	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	†6	3	0	3	56,918	41	33	0	0	0	3	3	0	0	1	16	17
Arkansas	21	15	0	6	62,133	340	260	1	0	0	3	4	7	0	2	45	54
California	38	32	0	6	178,786	672	732	2	0	0	3	5	19	0	2	148	169
Colorado	17	3	3	11	91,201	319	392	1	0	0	8	9	13	0	4	194	211
Illinois	37	14	0	23	79,072	793	1,176	0	0	0	7	7	9	0	1	181	191
Indiana	10	4	1	5	11,710	209	205	0	0	0	1	1	4	0	0	39	43
Kansas	63	31	7	25	221,204	1,427	1,723	2	0	2	4	8	43	0	10	215	268
Kentucky	25	6	6	13	42,086	474	567	1	0	1	4	6	12	0	4	86	102
Louisiana	44	23	8	13	312,634	1,264	1,286	1	0	2	6	9	29	9	31	156	225
North	17	11	1	5	42,342	440	495	1	0	0	3	4	4	0	2	44	50
South	26	11	7	8	263,788	590	632	0	0	2	3	5	18	8	23	96	145
Offshore	1	1	0	0	6,504	234	159	0	0	0	0	0	7	1	6	16	30
Michigan	10	6	0	4	29,497	134	157	0	0	0	2	2	4	0	0	53	57
Mississippi	9	1	0	8	80,575	122	151	0	0	0	4	4	7	0	0	48	55
Montana	14	6	0	8	54,844	112	111	1	0	0	5	6	3	0	0	36	39
Nebraska	16	4	0	12	90,418	262	322	1	0	0	8	9	15	0	0	127	142
New Mexico	36	23	6	7	162,540	675	614	0	0	0	1	1	26	1	5	69	101
Northwest	11	4	5	2	51,003	246	217	0	0	0	0	0	12	1	4	23	40
Southeast	25	19	1	5	111,537	429	397	0	0	0	1	1	14	0	1	46	61
New York	9	4	0	‡5	9,250	158	.....	0	0	0	0	0	0	0	0	0	0
North Dakota	4	2	0	2	27,797	98	80	0	0	0	2	2	5	0	0	32	37
Ohio	12	7	1	§4	34,267	343	363	0	0	0	0	0	0	0	0	3	3
Oklahoma	106	51	3	¶52	365,324	2,272	3,027	1	1	0	17	19	36	8	6	212	262
Pennsylvania	1	0	1	0	7,750	323	*311	0	0	1	0	1	0	0	13	18	31
Texas	420	256	8	156	1,794,602	7,457	7,391	15	2	0	82	99	226	22	72	1,623	1,943
Southwest (1 & 4)	46	21	4	21	190,441	910	1,089	2	2	0	14	18	32	8	21	272	333
Gulf Coast (2 & 3)	48	21	1	26	318,442	862	945	1	0	0	15	16	17	10	37	239	303
East (5 & 6)	18	12	0	6	99,048	431	379	0	0	0	5	5	4	0	2	128	134
N. Central (7-B & 9)	153	91	0	62	453,638	2,669	2,602	9	0	0	27	36	121	0	5	687	813
West (7-C & 8)	125	90	0	35	631,161	2,121	1,984	3	0	0	21	24	49	0	6	273	328
Panhandle (10)	30	21	3	6	101,872	464	392	0	0	0	0	0	3	4	1	24	32
Utah	5	3	0	2	28,024	60	30	0	0	0	2	2	5	0	2	29	36
West Virginia	4	0	2	2	17,439	211	232	0	0	0	1	1	0	0	7	3	10
Wyoming	8	7	0	1	36,894	263	247	0	0	0	0	0	10	0	2	80	92
Miscellaneous (S. D.)	1	0	0	1	1,740	26	52	0	0	0	1	1	0	0	1	20	21
Total United States	**916**	501	46	369	3,796,705	18,055	19,462	26	3	6	164	**199**	473	40	163	3,433	4,109
Total previous week	976	579	62	335	4,192,895	.....	.....	29	4	6	158	197	447	37	157	3,269	3,910
Total May 5, 1956	1,072	615	59	398	4,302,863	.....	.....	24	1	6	179	210	530	59	121	3,528	4,238
Cum., 1957	18,055	9,675	1,306	7,074	74,917,420	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Western Canada	19	17	0	2	106,177	851	803	1	0	0	1	2	21	0	17	193	231

*Incl. N. Y. †Incl. Fla. 2 dry, 15,441 ft. Service wells included: ‡5, §3, ¶6.

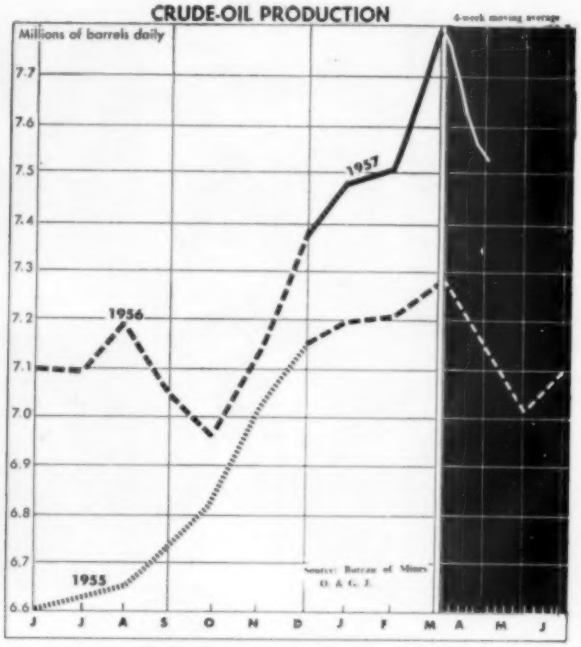
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

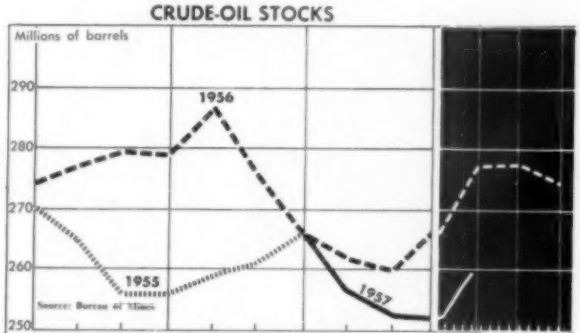


DAILY AVERAGE PRODUCTION FOR WEEK

	May 4, 1957 Crude oil	Lease condensate	Total	Apr. 27 total
Alabama	11,900	.....	11,900	11,850
Arkansas	85,150	350	85,500	83,600
California	928,400	.....	928,400	929,200
Colorado	157,750	.....	157,750	157,800
Eastern	51,000	.....	51,000	50,600
Florida	1,225	.....	1,225	1,225
Illinois	229,800	.....	229,800	228,300
Indiana	33,400	.....	33,400	32,300
Kansas	†372,750	.....	†372,750	†346,100
Kentucky	47,500	.....	47,500	47,100
Louisiana	867,950	73,200	941,150	952,200
North	130,300	3,200	133,500	131,700
South	737,650	70,000	807,650	820,500
Michigan	26,700	.....	26,700	28,200
Mississippi	110,300	4,375	114,675	114,950
Montana	72,250	.....	72,250	72,750
Nebraska	49,300	.....	49,300	53,500
Nevada	100	.....	100	100
New Mexico	267,250	4,600	271,850	274,400
North Dakota	26,600	.....	26,600	29,450
Oklahoma	†627,200	.....	†627,200	†622,500
Texas	3,131,575	53,800	3,185,375	3,205,250
Dist. 1	56,425	450	56,875	56,475
Dist. 2	152,000	8,350	160,350	163,750
Dist. 3	442,300	26,300	468,600	470,300
Dist. 4	239,000	6,300	245,300	251,600
Dist. 5	41,150	400	41,550	42,400
Dist. 6	138,275	6,000	144,275	146,000
East Texas field	208,150	.....	208,150	210,500
Dist. 7-B	167,575	75	167,650	168,075
Dist. 7-C	170,575	3,800	174,375	175,225
Dist. 8	1,190,700	1,100	1,191,800	1,196,400
Dist. 9	215,725	700	216,425	214,700
Dist. 10	109,700	325	110,025	109,825
Utah	11,100	.....	11,100	11,450
Wyoming	276,950	.....	276,950	288,550
Others	‡100	.....	‡100	‡100
Total U. S.	7,386,250	136,325	7,522,575	7,541,475
Change from previous week, down			18,900	
Canada	†494,800	.....	†494,800	†549,300
Total U. S. production, January 1-May 4			§944,704,150 bbl.	
Same period last year (crude plus cond.)			*900,601,775 bbl.	

*Includes 16,237,945 bbl. condensate. †Week ended previous Monday. ‡South Dakota. §Revised.

CRUDE-OIL STOCKS



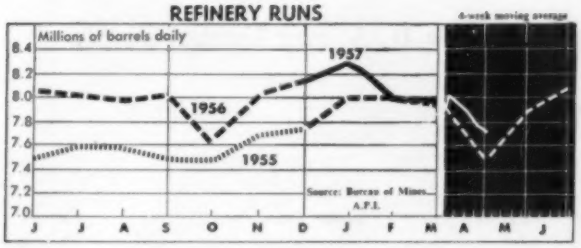
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

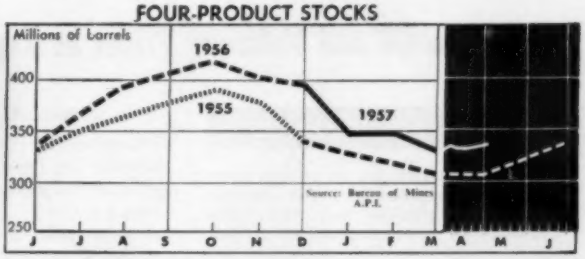
	4-27-57	4-20-57	4-28-56
Pennsylvania Grade	2,733	2,696	2,664
Other Appalachian	1,822	1,890	2,293
Illinois, Indiana, Michigan	9,055	9,276	9,790
Nebraska, North Dakota	1,855	1,894	2,214
Kansas	9,719	8,966	8,808
Oklahoma	22,401	22,437	25,614
Arkansas	2,842	2,753	3,033
Louisiana	18,321	17,877	16,488
North	2,815	2,828	2,584
South	15,506	15,049	13,904
Mississippi	2,304	2,225	3,029
New Mexico	6,936	7,204	8,120
Texas	118,565	118,521	127,751
East Texas proper	11,111	10,822	9,608
West Texas	55,811	55,606	63,243
Texas Gulf	21,550	21,713	22,403
Other Texas	30,093	30,380	32,497
Wyoming	17,032	16,689	16,874
Other Rocky Mountain	6,041	6,330	5,856
California	26,806	25,578	28,331
Foreign	†13,253	12,745	12,657
Total	259,685	257,081	273,522

*Bureau of Mines. †Includes 3,323,000 bbl. in California.

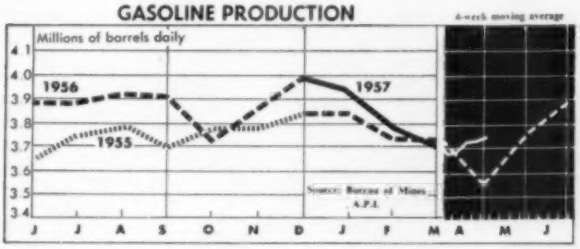
REFINERY RUNS



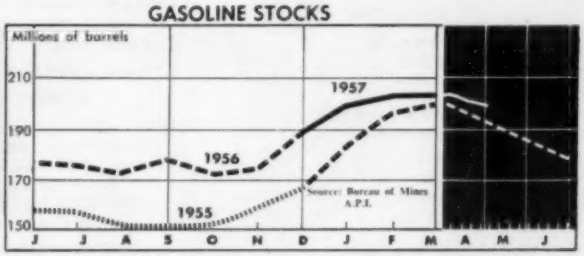
FOUR-PRODUCT STOCKS



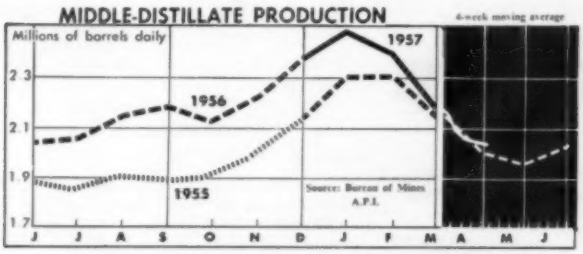
GASOLINE PRODUCTION



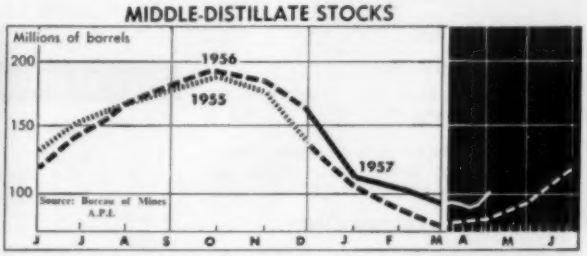
GASOLINE STOCKS



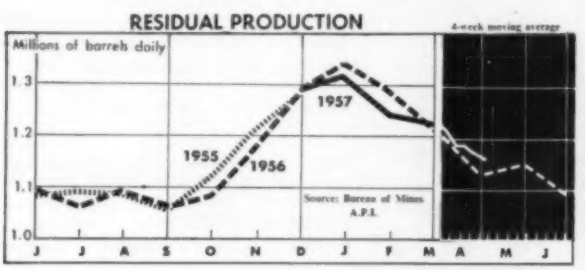
MIDDLE-DISTILLATE PRODUCTION



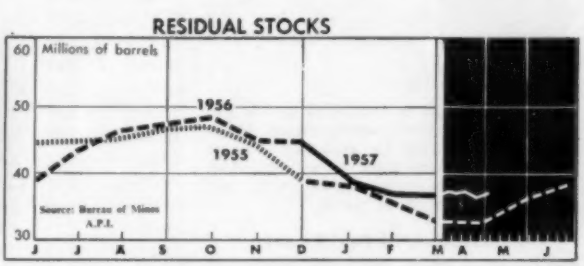
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, MAY 3, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, May 1956—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,131	495.3	44.6	300.4	207.3	43,111	9,076	24,726	9,411	1,043	417.0	27.6	239.6	196.5
Appalachian:														
District 1	85	34.6	3.9	18.0	7.3	4,947	439	1,690	499	93	35.5	3.7	22.4	4.0
District 2	107	56.8	3.1	16.7	13.6	2,791	381	550	356	106	49.7	4.0	17.2	15.0
Ind., Ill., Ky.	1,275	670.0	57.7	265.0	175.1	37,069	3,634	12,093	4,984	1,359	678.3	70.7	253.8	167.4
Minn., Wis., Dak.	87	41.7	6.0	27.4	7.6	6,353	364	3,306	385	79	36.7	5.0	22.4	5.8
Okla., Kans., Mo.	581	348.6	15.8	151.7	34.6	19,576	948	7,600	965	704	377.9	18.9	151.1	30.1
Inland Texas	271	191.3	9.0	52.0	21.3	8,098	266	1,566	1,708	280	199.0	8.4	52.6	24.0
Texas Gulf Coast	1,951	896.6	88.7	496.1	234.7	25,854	2,668	8,915	4,581	2,019	939.9	98.1	480.4	262.3
La. Gulf Coast	683	362.7	53.7	187.9	52.7	11,142	2,246	5,053	1,415	710	362.9	38.5	169.9	52.0
N. La. and Ark.	71	31.9	4.9	14.3	4.3	4,450	588	1,699	85	97	30.1	5.3	24.2	6.1
Rocky Mountain:														
New Mexico	28	13.3	0.6	5.0	3.4	390	10	83	65	22	11.6	0.4	4.1	3.2
Other Rocky Mtn.	253	122.7	2.6	56.6	32.8	7,739	240	2,460	1,055	270	121.5	3.8	63.4	32.7
California	1,110	479.4	2.0	160.9	341.3	26,812	305	9,378	12,062	1,114	496.0	7.8	165.5	349.6
May 3, 1957	7,633	3,744.9	292.6	1,752.0	1,136.0	198,332	21,165	79,119	37,571	7,896	3,756.1	292.2	1,666.6	1,148.7
April 26, 1957	7,634	3,744.4	235.4	1,764.6	1,191.3	200,222	20,163	74,898	36,800	.....	.....	.....	.....	.....
May 4, 1956	7,664	3,532.1	325.1	1,711.3	1,162.1	189,220	18,349	63,990	33,216	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (88 octane)	11.75-12.25
Premium (96 octane)	13.50-14.00
Gulf Coast (cargoes for coastwise or export movements):	
★ Regular (90 octane)	10.75-11.25
★ Regular (92 octane)	11.00-11.50
★ Premium (97 octane)	12.75-13.25
★ Premium (98 octane)	13.00-13.50
California (rack):	
Regular (86 octane)	13.1
Premium (93 octane)	15.3
Premium (96 octane)	16.2
Caribbean area (cargoes):	
★ Regular (87 octane)	10.875
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
★ Grade 26-70	4.0
Breckenridge:	
★ Grade 26-70	3.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	10.00-10.375
Diesel oil (58 d.i. and above)	9.625-9.875
Distillate No. 1	9.625-9.875
Distillate No. 2	9.00-9.375
Gulf Coast (cargoes):	
★ Kerosine 41-43	10.25-10.75
★ Distillate No. 2	9.75-10.25
New York Harbor (barges):	
Kerosine 41-43	12.25
Distillate No. 2	11.65
Diesel fuel, 48-52 d.i.	11.95
Caribbean area (cargoes):	
Distillate No. 2	10.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max 1% S)	$2.25-2.35
Gulf Coast (cargoes):	
Bunker C fuel	$2.75-3.00
New York Harbor (barges):	
Bunker C fuel	$3.20
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.89
16-16.9	2.74	....	....	....	1.94
17-17.9	2.78	....	....	....	1.99
18-18.9	2.82	....	....	....	2.04
19-19.9	2.85	....	....	....	2.09
20-20.9	2.89	$2.75	....	$2.62	2.14
21-21.9	2.93	2.77	....	2.64	2.19
22-22.9	2.97	2.79	....	2.66	2.24
23-23.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low Cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, Jenuary 3-January 10, 1957; Pennsylvania Grade, January 16, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.88
Middle District	4.70
Southwest Pennsylvania	4.41
West Virginia	4.23
Buckeye Grade	4.23
Zanesville Grade	3.27
Illinois Basin	3.15
Canada:	
Leduc-Woodbend	2.78
Redwater (Alta.)	2.67
Smiley (Sask.)	2.44
Pembina	2.65

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 40°-40.9°, Puerto La Cruz	3.37
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$1.97
Iranian, 34.0°-34.9°, Bandar Mashur	1.91
Iranian, 34.0°-34.9°, Abadan	1.86
Iraq, 36.0°-36.9°, Fao	1.87
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.72
Qatar, 39.0°-39.9°, Umm Said	2.06
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Iraq, 36.0°-36.9°, Tripoli, Banias	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°-38°	2.60

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

Gulf-U.S.N.H., clean (USMC—20%)	$2.28
★ Gulf-U.S.N.H., dirty (USMC—27.5%)	2.07
★ N.W.I.-France, dirty (USMC—35%)	4.26
P.G.-Japan, dirty (USMC+7.5%)	9.68

SUPPLY AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels daily)

GASOLINE

	Total demand	Refinery production	Stocks end of period†
April 1957*	3,990	3,740	198,870
March 1957*	3,855	3,709	203,000
February 1957	3,597	3,789	205,270
May 1956	4,093	3,756	186,673
April 1956	3,859	3,557	193,299

KEROSINE

April 1957*	250	283	20,880
March 1957*	375	328	20,000
February 1957	467	353	21,013
May 1956	179	292	21,883
April 1956	272	299	18,227

DISTILLATE

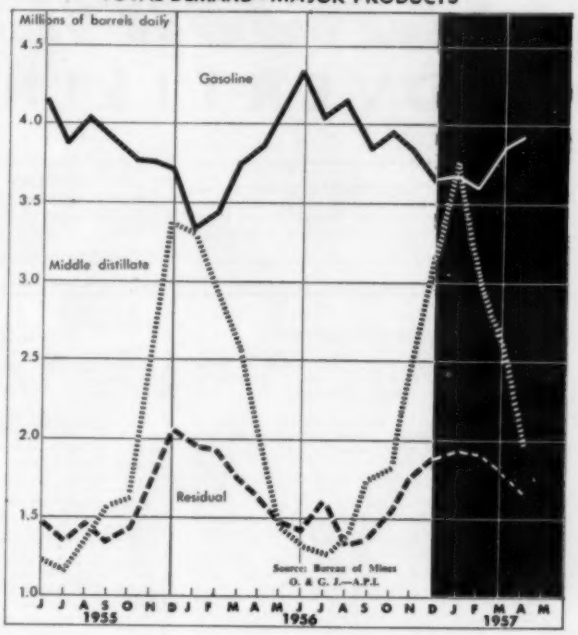
April 1957*	1,710	1,760	77,900
March 1957*	2,217	1,863	75,600
February 1957	2,620	2,035	85,105
May 1956	1,286	1,667	75,928
April 1956	1,640	1,713	63,571

RESIDUAL

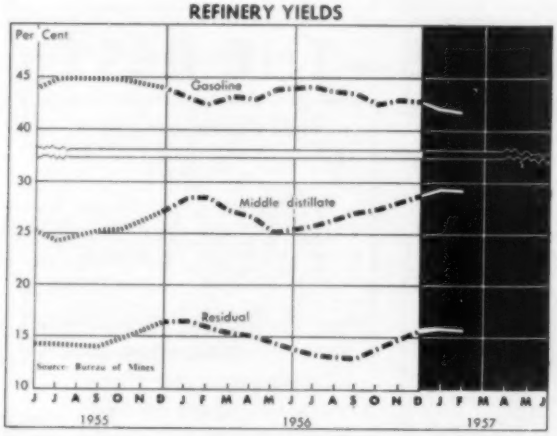
April 1957*	1,675	1,163	37,350
March 1957*	1,811	1,221	37,100
February 1957	1,946	1,269	36,201
May 1956	1,478	1,149	36,607
April 1956	1,622	1,130	32,740

*Preliminary. †Thousands of barrels.

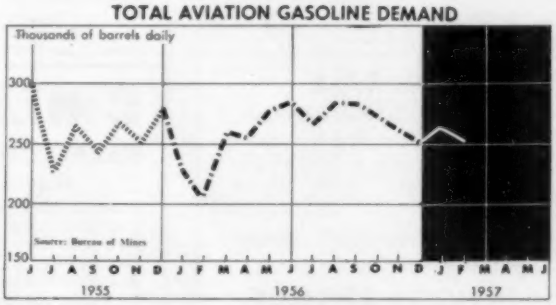
TOTAL DEMAND—MAJOR PRODUCTS



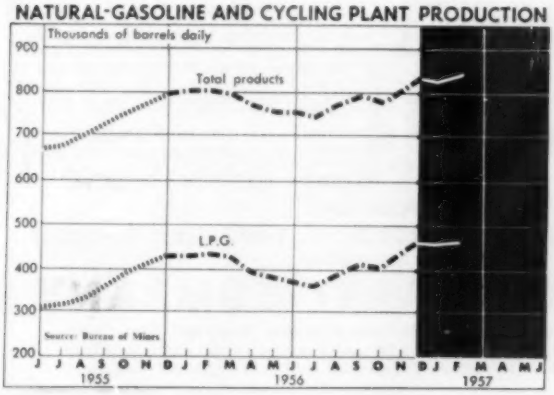
REFINERY YIELDS



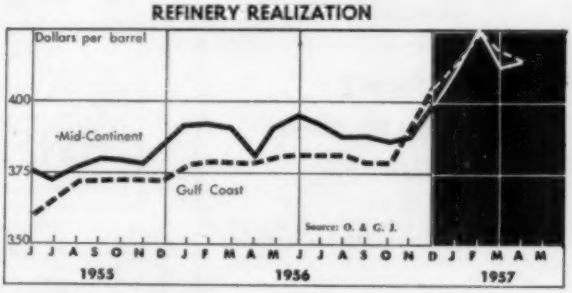
TOTAL AVIATION GASOLINE DEMAND



NATURAL-GASOLINE AND CYCLING PLANT PRODUCTION



REFINERY REALIZATION



REFINERY REALIZATION

	Apr.* 1957	Mar.* 1957	Feb. 1957	Apr. 1956
Mid-Continent	$4.15	$4.13	$4.23	$3.80
Gulf Coast	4.15	4.19	4.24	3.78

*Preliminary.

Refinary realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel, and residual as published in The Oil and Gas Journal.

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ONE GASO #1849 (4x6) duplex pump. Mounted on skid with Mercury motor. Also one 1948, I.H.C. Tandem truck in fair shape with good tires. United Oil Well Cementing Co., Inc., Phone 1426, El Dorado, Kansas.

1—NEW 33'6" Vertical, 3 Section, 6 Tray, Lead Lined Drying Column, Upper Section 5' ID, Lower Sections 2'8" ID, located Borger, Texas. Contact L. F. Mayfield, Phillips Petroleum Company, Bartlesville, Oklahoma.

PRICED TO SELL, 5500' Wilson Giant Rotary Rig complete. Brown & Martin Drilling Co., Box 731, Gainesville, Texas. Call HOward 5-2272.

FOR SALE—Cardwell Spudder, RL502, complete with tools, equipment necessary for efficient operation. Price, inventory on request. K & A Drilling Co., Phone 448R, Box 497, Ellinwood, Kansas.

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COMPLETE carload ethyl plant dismantled and ready to load. Bargain price. Box 1858, W. C. Berry, Tulsa, Okla.

HEAVY DUTY 19' all steel tandem oilfield bed with Braden M30-144 winch, complete. Grant rolling tailboard and Texas poles. Priced to sell. Edd Noland, Box 229, Phone 102, Chanute, Kansas.

N-3 BREWSTER Drawworks complete with 1 GZBU Waukesha 20 months old—excellent condition. Price $13,750.00. Contact IVERSON SUPPLY COMPANY, Odessa, Texas. Phone FEderal 7-2349.

FRANKS IMPROVED MODEL 7000 Double Drum Workover Unit complete with Telescoping Derrick mounted on 6x6 FWD Truck for sale by sealed bid.

For additional information call or write

Schio Petroleum Company (WEHLU)
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VI 3-5343, Oklahoma City.

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FOR SALE: 600 tons Carnegie MP-115 42 ft. & Larssen Section II 30 ft. and 40 ft. lengths steel sheet piling located New Orleans and Tampa. Seaboard Steel Company, Tel. RIngling 7-0461, Sarasota, Florida.

32 DRILL COLLARS, 20 ft. OD, 5", ID 2 in., 41-40 heat-treated steel, BRAND NEW. $300 each. Ask for Ralph Varel. FL 1-6487, Varel Mfg. Co., 9230 Denton Dr., Dallas.

C-34 WALKER-NEER Spudder, with or without 5-7 tools. A-1 condition. Fully equipped. Located at Drumright, Oklahoma Box 788 or phone 20, Drumright.

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TWO COMPLETE DRILLING RIGS
NATIONAL—110—purchased Aug. 1955.
CLARK—PR-1,000

Both rigs complete in every detail—inventory on request. Have been drilling W. Tex., now stacked. H. R. Dickerson, Pres., **SABINE DRILLING CO.**, 814 Commercial Nat. Bk. Bldg., Shreveport, La., Phone: 3-5285.

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A clean D7 Caterpillar tractor, series 4T with an inside hydraulic 8' blade and a D7N Hyster worm driven winch. Serial #19131.

For further information concerning this equipment call

HENSON DRILLING COMPANY

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300,000'

2⅜" OD 4.7# New E.W. Hydrostatically tested 3500 PSI Range 2 External Upset Ends T&C in carload lots only.

$51.00 CFT FOB MILL
$55.00 CFT DELD SOUTHWEST AREA

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FORMER LACY REFINERY

1—Wyatt 30" x 70' Stabilizer 160# 30 tray
1—5' x 90' tower, 40 tray, 135# WP.
1—3' x 50' tower, 24 trays.
1—Ethyl lead plant.
2—Upshot heaters, 10 mil. BTU/hr.
8—Welded storage tanks, 5,000, 2,000 bbl.
8—Hi-vol pumps, 10 x 7 x 18, 10 x 6 x 12, 6 x 4 x 12, 6 x 3 x 8.

IN STOCK

VESSELS

2—12' x 45' Storage Tanks, 25#
1—14' x 21' Clay Tower, 125#
1—8' x 75' Tower, 20 Trays, 25#
1—18" x 32' Tower, 15 Trays, 160#
2—8½' x 25' Tanks 80#
5—Packed Towers 14" x 40', 18" x 23', 160# Wyatt 1950.
1—Poly Reactor, 550#, 24" x 28'.

HOT-OIL PUMPS

3 Pacific ITB, 400 gpm—2,000' hd, 725 gpm—3,100' hd.
5 Pacific SVTB, 612 gpm—600' hd, 324 gpm—480' hd, 308 gpm—316' hd, 193 gpm—389' hd.
1 Pacific HVTB (unused) 1270 GPM—408' Hd.
8J hot oil pump 3 x 9, 13 st, 325 gpm, 4600' hd.

HEAT EXCHANGERS

4—Kellogg Adm. Ftg. Hd. 2200, 1300 Sq. Ft., 315#
4—Kellogg Stel Ftg. Head. 800, 650, 500 Sq. Ft.
18—GR Fin Tubes, 73 Sq. Ft.
6—Brown fintube exchangers, 300# 140 Sq. Ft. 4-6 chrome.
5—Steel 1,000, 900, 800, 600, 500 Sq. Ft.
6—Adm. 785, 742, 425 Sq. Ft.
30—304 SS shell & tube condensers 100-1000 Sq. Ft.

COMPRESSORS

1 Worth LTC-6 800 hp.
3 Penn Comps 100 CFM 500 lbs.
385 CFM 160 lbs.

MISCELLANEOUS

6—Bird Centrifugals 32 x 50, 24 x 38, 18 x 28.
5—Sweetland Filters No. 12, No. 10, No. 7, No. 5.
4—Rotary Vac. Filters, 10 x 12, 8 x 10, 5 x 8.
Lab Petro-Chem furnace 50,000 BTU/hr.
Tremendous selection stainless steel and steel valves 1½"-8".
Goulds 16" pump, 10,500 gpm, 135' hd.

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NEW ¾" HPR-10 and HPR-20 Cast Bronze Reliance Regulators. Excess from construction. Priced to sell. Write for full details. Southeast Alabama Gas District, Box 271, Andalusia, Alabama.

WILSON GIANT Roadair Drawworks with 36" Hydromatic, 2—L3000 LeRoi engines, single pump compound, catheads, air compressor, etc. Completely overhauled. Top A-1 condition. Also 64B Oil Well drawworks with 36" Hydromatic, pump compound, catheads, 2—8 cyl. LeRoi engines. Both units reasonably priced. Liberal terms to responsible party. Rig Supply & Rental Co., Box 2406, Casper, Wyo. Phone 2-5870.

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PRICED TO SELL. Cardwell RL Spudder, rated 7500' drilling, powered Waukesha 200 HP engine, good cables. Pressey & Son, Pueblo, Colo.

NEW CHROME HEATER TUBES, 54 joints, 17 to 23' lengths, 2" O.D. x .238 Wall, Type 446 Stainless Steel, Seamless, 26.05% Chrome. Immediate Shipment. W. Russell Pryor, 2502 Robinhood Road, Houston 5, Texas. Phone JAckson 3-3132.

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USED LATE MODEL 71 and 72 Speedstars, 24L and 28L Bucyrus, all complete with tools. Star Drilling Supply Co., Manufacturers of Rotary and Cable Tools, Chanute, Kansas.

COMPLETE PIPE-THREADING shop. Two Landis machines 13⅜" and 7", with building, fully equipped. Bargain. Phone Diamond 3-9563. Lundquist, Box 1215, Tulsa, Oklahoma.

FAILING 1500 H.D. drill with 4½x6 pump, automatic pulldown, mounted on 1948 F7 Ford. Also Griffin water tank, mounted on 1951 Ford. Write P. O. Box 819, Longmont, Colorado. Phone 1333.

SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment; from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply Co., Tulsa.

ONE GARDNER-DENVER Mud Pump, Model FQ-FXQ (7¾" x 16") Serial No. 110920. On short steel skids. 18 groove 53" shive. Good condition. Turner Equipment Company, Phone FE 7-6562—Nights FE 2-5751, Odessa, Texas.

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Modern 15,000 Bbl./Day Refinery

Presently being dismantled — Immediate removal and shipment — exceptional prices

HOUDRIFLOW CATALYTIC CRACKING UNIT, 8800 BBL./DAY (NEW 1952)

TOWERS

8'x5'x85'6" 25 Trays 250 PSI
8'x34'6"x½" 10 Trays
6'x30'x½" 9 Trays
4'6"x30'5"x⅜" 14 Trays
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3'x23'6"x1¼" Catalyst 600 PSI (2)

ETHYL BLENDING PLANT 8500 GAL. COMPLETE SKIMMING POND

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6'x40' SOAKER, 500 PSI @ 850° F.
20'x28'4" AGITATOR, cone bottom
10,000 bbl. HORTONSPHERE
6500 gal. PROPANE TANK

50,000#/HR. COCHRANE WATER TREATING AND DEAERATING PLANT

HEAT EXCHANGERS

Sq. Ft.	Type	Tubes	Shell
1080	Reflux	Adm. 125#	Steel 250
993	Reboiler	Steel 600#	" 600
970	"	" 125#	" 250
750	"	" —	—
331	16-138	Adm. 250#	Steel 250
331	16-138	Adm. 125#	" 250
Brown	Fintube	Steel 600#	(11)

110,000 GAL. FOAMITE SYSTEM—COMPLETE

VACUUM CRUDE DISTILLATION UNIT, 15,000 BBL./DAY (NEW 1953)

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500—New Croloy #5, 3" to 6⅝" OD 15' to 32' long
500—4", 4-6% Chrome, headers
200—4½", 4-6% Chrome, headers
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UPSHOT HEATER COIL TYPE "D" 3" PIPE 600 PSI—417 SQ. FT. GAS FIRED

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HOT OIL 334 GPM, 1,000 PSI (2)
FIRE 2500 GPM at 426' head
CENTRIFUGAL from 60 to 1500 gal. from 40' to 655' head
STEAM—Hot Oil—Simplex—Duplex
PROPORTIONING—1 to 5 HP

2-28 SPOT CAR LOADING RACKS, CAPABLE 10 PRODUCTS EACH SPOT

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1000 M CFD COOPER GAS COMPRESSOR
HEAT EXCHANGERS—196-3100 sq. ft. (25)
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10 Ton OVERHEAD TRAVELING CRANE
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800 H.P. Worthington. May be seen in operation. Like new. Too large for present job. Owner will sacrifice. Call:

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Workover and Fishing Tool Operators

FOR SALE 5300 feet of 2⅞" OD 10.40# Grade D R-2 Internal Upset (1¼" ID) #1 Seamless Drill Pipe with Hughes Acme Regular Tool Joints attached. Above pipe used short time by recently merged oil company, and tool joints in excellent condition. Priced to sell FOB Corpus Christi @ $1.39 per foot.

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Corpus Christi Division
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CORPUS CHRISTI, TEXAS

R. E. KERSHAW CO.

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New Titpon Pipeline Line-Up Clamps

12—30"	w/Hyd.	Jack	$99.90
6—24"	"	"	80.10
15—18"	"	"	71.10
8—16"	"	"	66.60
2—36"	w/o	"	79.20
1—30"	"	"	73.80
1—24"	"	"	47.70
3— 4"	"	"	13.00

BARGAIN PRICE

New 222—4½" OD x 2⅞" Bore Hinderliter API Full Hale Rotary Tool Joints for 3½" OD API Internal Upset Drill Pipe.

CONTACT
EL PASO NATURAL GAS COMPANY,
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LIQUIDATION 11,000 BBL. REFINERY

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We are now liquidating this modern refinery and can offer equipment at a fraction of its cost.

INCLUDED ARE: 6 Heaters with Chrome Tubes, Welded Towers from 2' to 8' with Operating Pressures up to 475 psi., Reboilers, Accumulators, Heat Exchangers, Hot Oil Pumps, Centrifugal and Steam Pumps, Boilers, Gas and Diesel Generator Sets, New Chrome Heater Tubes, Pipe, Valves, etc.

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1 36L BUCYRUS Spudder complete with 5 and 7 inch tailing in tools. Dog house, butane tank, junk rack and light plant. Rod and tubing tools and hand tools. Phone Office 144, Res. 615, Cleveland, Oklahoma.

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WANT 36L or 32 SPECIAL Walker-Neer on rental-purchase basis. Rig must be in top condition for major company operation. Semi-trailer mount, 5" and 7" tools for 3000 ft. drilling and workover. We can offer excellent opportunity to anyone caring to dispose of their rig on a one year payout basis. State price, terms you want, and location where rig may be inspected. Deal only with principals. Box K-149, The Oil and Gas Journal, Tulsa, Oklahoma.

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Graduate engineer with experience in oil producing operations including pressure maintenance, secondary recovery, primary and depletion. Initial assignment in New York office in reservoir engineering and research section concerned with oil field development studies. Salary and position commensurate with qualifications.

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Independent oil company has opening for petroleum engineer with four to seven years experience both technical and administrative for responsible position in planning and control. Knowledge of operating procedures, some valuation work and practical oil and gas law would be desirable. Excellent growth opportunities. Please furnish complete details on qualifications, including starting salary required.

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The Oil and Gas Journal,
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Position open for graduate automotive or chemical engineer with knowledge of gasoline behavior research. The work is varied in nature and requires capable man to coordinate research, author technical publications and maintain contacts within the industry. Position offers immediate responsibility in a growing technical service activity. Location in a Detroit suburb offers ideal professional environment with a choice of city or suburban living. For more particulars send name and address to:

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REFINERY ENGINEERS

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For engineering staff of new refinery near Hattiesburg, Miss., consisting of TCC, Fluid Coking, Alkylation, Platforming-Unifining, Sulfur Production, Treating, and fractionation facilities.

Chemical Engineers:
1 - 5 years experience technical service, process design, and economics.

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Inspectors:
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Draftsmen:
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Write, giving details of experience and applicable information, **immediately**, to:

Pontiac Eastern Corp.
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HELP WANTED

WANTED

Associate and Assistant Professors of Petroleum Engineering

If you have a Ph.D., some experience, and want to teach a select group of students in a leading western institution with facilities for research, and are young, able, and personable, communicate with the Dean of the School of Mineral Sciences, Stanford University, Stanford, California.

Experienced Asphalt Sales Engineer

Must be thoroughly familiar with pricing and specifications and have wide acquaintance. To be located in Mid-Continent area. Good opportunity for right man. State age, experience and starting salary expected. All replies will be kept strictly confidential.

Box K-129,
The Oil and Gas Journal,
Tulsa, Oklahoma.

HELP WANTED

CHEMICAL ENGINEER. Independent Oil Company needs Chemical Engineer under 35 with general knowledge of, and experience in construction, operation, and maintenance of gasoline plants, gathering systems, compressor stations, gas pipe lines, and related facilities, for permanent position in Louisiana. Knowledge of process engineering also helpful. Furnish information as to education, family status, work history, and salary requirements to P. O. Box 2162, Dallas 21, Texas.

EUROPEAN OPPORTUNITY

Project manager required for European office of international consulting firm supervising technical aspects of construction and early operations of entirely new refinery. At least one year's service with good possibility of remaining in refinery operations. Require mature graduate engineer with refinery experience and good general knowledge of oil business. Excellent location in one of Europe's most attractive cities. Family transportation and living allowance included above excellent salary. Send resume to:

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The Oil and Gas Journal,
Tulsa, Oklahoma.

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DEVELOPMENT GEOLOGIST to develop reservoir geology of producing fields and recommend drilling programs; experienced in logging and testing techniques. Initial work in South Texas with eventual coverage of North America. Box K-151, The Oil and Gas Journal, Tulsa, Oklahoma.

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INTEGRATED OIL COMPANY

Applicant would work with Vice President in charge of Crude Oil Department (sales and exchanges), foreign and domestic, of integrated independent oil company domiciled in California. Should be under 45 and had experience in this type of work and have knowledge of tankship chartering, preparation of lifting schedules and documents, and a working knowledge of crude and products specifications. Job will require foreign and domestic traveling. Salary commensurate with experience and ability. If applicant now employed, replies will be kept confidential.

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All information confidential.

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HELP WANTED

DISTRICT GEOLOGIST: Established independent desires geologist experienced in all phases of petroleum exploration, must have chief geologist qualifications. State salary and resume. Box K-145, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEERS WANTED: By crude oil pipe line operating company for general engineering. Applicants not over 30 years of age and must have a recognized degree in engineering from an accredited engineering school. Experience not essential. Salary based on experience and qualifications. When making application, please furnish resume of experience record, personal data and copy of college transcript. Reply to EMPLOYEE RELATIONS DEPARTMENT, Interstate Oil Pipe Line Company, P. O. Box 1107, Shreveport, Louisiana.

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PETROLEUM ENGINEER—32, B.S. Degree, married, 6 years broad experience in drilling, production, workovers, evaluation and all phases of gas production and operation. Desire permanent position with good opportunities in substantial organization. Presently employed. Box K-174, The Oil and Gas Journal, Tulsa, Oklahoma.

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GRADUATE Petroleum Engineer: 3 years varied experience in production, drilling, completion and workover in Permian Basin. Military obligation fulfilled, married, age 25. Desires responsible position in petroleum industry. Box K-169, The Oil and Gas Journal, Tulsa, Oklahoma.

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The Arkansas Tuberculosis Sanatorium owns approximately 3800 acres of minerals under an approximate 7300 acre surface which it desires to lease for exploration for oil, gas and/or other minerals.

Details may be obtained by writing the undersigned.

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SUPERINTENDENT
Arkansas Tuberculosis Sanatorium
STATE SANATORIUM, ARKANSAS

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1957 GULF COAST Oil Directory covering the Texas and Louisiana Gulf Coast. Personnel listings, titles, addresses and telephone numbers of producers, drilling contractors, supply companies, special services, seismograph, specialties, manufacturers, well service and work-over, transportation, construction, and allied industries. $5.00 per copy. Write Box 14265, Houston, Texas.

WANTED

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WANTED—Semi-proven or proven leases or farmouts in South Texas or Gulf Coast. Please send complete details in first letter. P. O. Box 1937, San Antonio, Texas.

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OIL PRODUCTION FOR SALE: #1 Well completed 1951 (Never Hydrofraced). #2 well completed 1955, Cypress Sand, Illinois, 40 acre lease, 2 undrilled locations, 10/16 produced $14,161.20 income 1956, operating expense $1,419.80. Complete records. Top management. Box K-172, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION WANTED

WANTED FOR CASH—Depleted and Marginal Wells for Salvage. Frank J. Black, P. O. Box 150, Phone 107, McPherson, Kansas.

WANT TO BUY—Oil Properties, settled or semi-settled production. 100 to 5,000 barrels daily in Oklahoma and Kansas. Contact Morris Sitrin, 1215 First National Building, Tulsa, Oklahoma.

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LEGAL

U. S. DEPARTMENT OF THE INTERIOR Bureau of Land Management, Land Office, Cheyenne, Wyoming. Notice is hereby given that approximately 2198.61 acres of land in 27 parcels within the known geologic structures of the Mush Creek, Skull Creek, Southeast Skull Creek, Clareton, and Fiddler Creek fields, Weston County, Wyoming, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre through sealed bids on or before June 5, 1957, when bids will be opened. Details of the lease offering, and how and where to submit bids, may be obtained from the Land Office, Cheyenne, Wyoming. Craig A. Decker, Manager.

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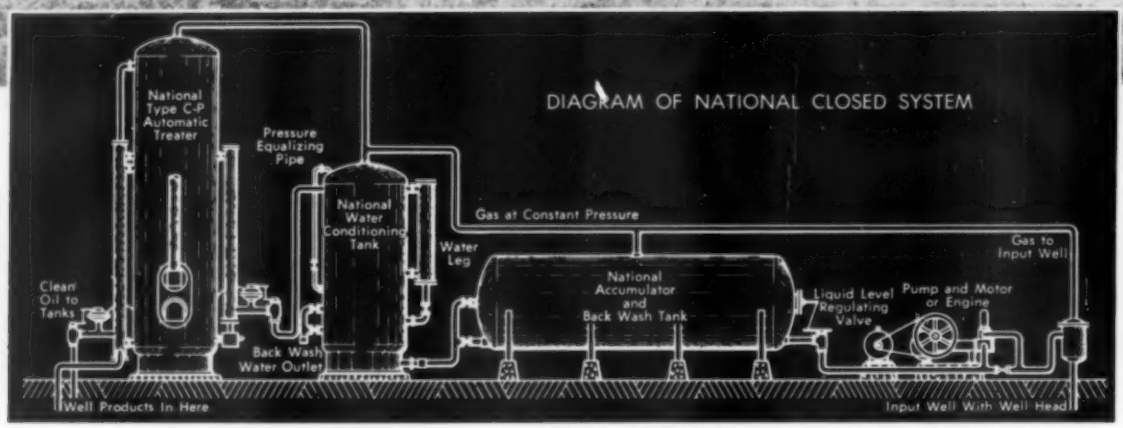
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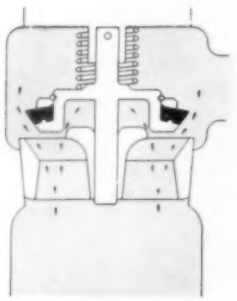
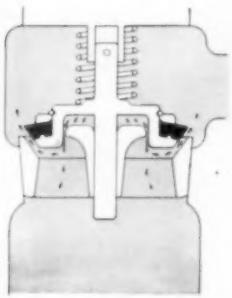
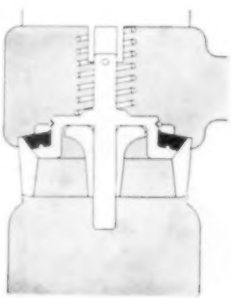


1 Above diagram shows the valve in fully opened position . . . mud has filled the chamber and also the cylindrical area of the valve.



2 As the valve starts to close . . . mud, which is trapped in the cylindrical area of the valve, is squeezed out around the restricted area between the mushroom and the valve.



3 As the valve nears fully-seated position . . . rubber insert contacts seat first and, as mud is entirely squeezed from between the valve and mushroom on the seat, shock is cushioned and the valve fully seats, with no excessive pounding.